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The Properties of Tungsten Filaments.

We are glad to present to our readers some account of the foreign work on tungsten lamps and especially such facts as have become known regarding the nature and preparation of the filaments. The fundamental value of tungsten for incandescent lamps lies in its enormously high point of melting, or volatilization, as there is some doubt about its actually melting prior to pasing into vapor. In this respect it perhaps resembles carbon and the nonmetallic elements, as should indeed be expected from its chemical position. As a metal in the common sense of the word, tungsten is unknown. It has not yet, for instance, been reduced to an ingot from which anything could be hammered or cut or drawn, and perhaps it never can be so treated. Therefore, so far as is now known a filament of wire such as is used in the tantalum lamp cannot be produced from tungsten, and the filaments made for use in the tungsten lamps have to be obtained by roundabout methods, and when completed are, like carbon filaments, aggregates of amorphous structure or of infinitesimal crystals. The processes in use for making the filaments seem to be of three distinct kinds. The first is the outgrowth of attempts to coat a carbon filament with tungsten after the manner tried in the work on osmium lamps. It results in the simultaneous dissolution of the carbon filament and its replacement by finely divided tungsten further strengthened by a process akin to flashing, i.e., the still further heating of the filament in the vapor of a tungsten compound.

The other two processes start with very finely divided tungsten and consist in making a paste from which the filaments are formed. Further treatment is given by firing. The earlier processes deal with a paste made as it were of precipitated tungsten; the later one starts with the so-called colloidal metal which presents the advantage of almost infinitely fine subdivision. Whether the filament is prepared by the substitution process, the paste process or the colloid process, the result is of the same character—a thread perhaps 1 to 2 mils in diameter of compactly aggregated pure or nearly pure tungsten. These filaments are dense and of smooth and uniform appearance, but thus far have seemed to be very brittle, as might be anticipated from their structure. The elimination of this excessive brittleness is the crux of the tungsten lamp problem. The filaments can be worked at one watt per hefner (the value of the hefner according to a recent Reichsanstalt determination is .909 candle), or thereabouts, with a life that is claimed to be one to two thousand hours, with exceptionally small loss of iluminating power. Indeed, some tests have shown an actual increase of efficiency after several hundred hours of use. It appears to be extremely difficult to produce lamps of the ordinary voltages and moderate power. The specific resistance appears to be quite low as compared, for instance, with osmium or tantalum, so that the filament in a tungsten lamp is both long, requiring several loops in series and extraordinarily slender. Like the osmium filament it seems rather plastic when hot and must, so far, be burned in a vertical position. The intrinsic brilliancy is very great as compared with any other incandescent lamp and the light is probably as nearly pure white as can be obtained. The extreme fineness of filament required for lamps of ordinary power suggests that the best use of the material at present is for lamps of large candle power, which would

prove invaluable in replacing the blue flickering arcs of small amperage. A final result of this condition may be the displacement of the present inadequate 16-cp unit by 25 or even 40 cp, thus placing the electric lamp in a better position with respect to the Welsbach. It is, of course, quite impossible to predict the probable growth of the tungsten lamp. It is new and promising, but has many difficulties to contend with before it can find its full place. It is now far enough along, however, to say with confidence that it will find important use, if only for large units. Its general use hinges on the success with which the filaments can be made for moderate candle power without prohibitive breakage; and many recent tests, we believe, point that way, and justify confidence in the new illuminant as an enormously beneficial factor in the incandescent lighting field. In any event, the carbon filament may soon be a thing of the past.

The Ohio Electric Light Convention.

A partial report of the convention of the Ohio Electric Light Association, held at Put-In-Bay last week, will be found in this issue. The Ohio convention this year followed the precedent of several years previous in being very prolific in good papers. In this respect it is second only to the National Electric Light convention. Considering the limited number of sessions, it would probably be better to attempt less in the way of papers and allow more time for discussion; and each paper should be discussed immediately following its reading while its subject is fresh in the minds of all. There is always a possibility that the weather in August, even in as relatively cool a place as Put-In-Bay, may interfere with convention sessions, and the association this year certainly labored under a hot weather handicap which has never been equalled by any convention of the kind since the memorable National Electric Light convention at Cincinnati in 1902.

Ohio conventions have been notable in securing for papers first published descriptions of new appliances of more than ordinary interest to the electric lighting industry. The informality of a State convention naturally leads to the presentation of some important details that would hardly be presented to a national body. For example, the Ohio proceedings this year contain the first published description of the series luminous arc lamp and rectifier system as used in this country in its present form, thus making an interesting supplement to the paper on the results of this system at Portland, Ore., which was presented by Mr. Barstow to the National Electric Light convention in June. The system appears to be taking a place where it is an important factor in street lighting work where large units are desirable. The testimony as to economical and satisfactory operation of the system by various central station companies is encouraging, and justifies the belief that the costs of trimming and electrodes are not as heavy in the present magnetite lamp as in earlier forms, and hence leave a balance in favor of the luminous arc when compared with the series enclosed arc system. The announcement of a new type of "inverted bowl" reflector to go over high-efficiency incandescent lamps which will cover the lamp well so as to avoid glare and at the same time illuminate evenly a large area under the lamp, is a more important step in the art than many realize. On this we shall have more to say later. In connection with heating devices, the convention was given a deeper insight into the construction and essentials of design of some well-known heating apparatus than has heretofore been afforded a group of central station men. It was also given some excellent pointers on the necessity of central station men studying details and personally trying and installing electric cooking utensils before attempting to push electric heating devices. In fact the papers by representatives of the manufacturing companies presented at this meeting were much above their usual average, none being open to the reproach of being merely perfunctory commercial presentations.

Methods of securing business occupied an important share of the time as it has at all electric light conventions recently. Among some of the more notable specific suggestions brought out by the convention is the method of Mr. D. W. Low, of Alliance, in rapidly building up the day load by purchasing and installing a considerable number of good-sized motors on trial after the manner of the free trial flatiron campaign of numerous companies. The perfected plans of the Cleveland Electric Illuminating Company for the carrying on of a large residence wiring business, to be paid for by customers on the installment plan, were outlined by Mr. Turner.

As was natural, the Columbus rate decision case upon which we have previously commented was referred to a number of times by various speakers. This decision, while of immediate importance to Ohio companies, is also of considerable interest and value to all companies in the United States, because of the precedent which it establishes and the dampening effect it is likely to have on rabid rate regulation. It will be well if the Columbus case brings home to Ohio and other central stations the importance, as urged in Mr. Russell's presidential address, of analyzing and keeping records of costs of production for various classes of consumers. The company which keeps the best system of records of costs is the one which is least likely to have trouble when rate regulation is talked of. If a company has no figures with which to back up its position that its rates are properly adjusted, it has but little with which to appeal to the rational element in a legislative body. Furthermore, a system of rates which will secure all classes of business at a profit cannot be worked out without a careful analysis of costs of production, nor can a system of rates which varies as widely between its maximum and minimum limits as must that of any progressive central station company, be justified before a public investigating committee unless such records are kept and costs analyzed.

Boiler Room Economy.

It is generally conceded by the best of operating engineers that in the majority of power stations there is a far better opportunity to make improvements in economy in the boiler room than in any other part of the plant. The article by Mr. R. B. Holbrook elsewhere in this issue tells where and how to look for some of the common boiler room losses. The reason for the indifference to boiler room losses in the majority of plants otherwise well managed is probably that in the engine and generator part of the plant conditions are fixed to a much greater extent than in the boiler room. Once the valves of an engine are set correctly, an engine operates at best economy until some years of wear begin to tell upon it. The efficiency of the generator is practically fixed by the manufacturer. In the boiler room, on the other hand, the opportunities for variation of operating conditions are infinite. Almost everything depends on the skill and personal peculiarities of the men in charge. Mr. Holbrook shows the numerous ways in which economy can be de-

feated. In the boiler room it is not a case of adjusting a piece of apparatus right and then simply operating it month in and month out. It is rather a case of eternal vigilance every minute of the day. No boiler plant can long be economical unless such vigilance is displayed. Bearing also on full economy we print in this issue the first of a series of articles on the burning of cheap fuels, and another by Mr. E. H. Peabody treating specifically of the burning of small anthracite coal. As the subject is one of much interest to central stations, we shall welcome communications from our readers who have had experience in burning low-grade fuels.

The Grounding of Transformer Secondary Systems.

The practice of grounding the secondary of all high-tension lighting transformers is steadily extending. Nevertheless, there are still many places where the practice is not carried out. If the complete insulation of the secondary from the primary system could be guaranteed under all circumstances, there would, of course, be no necessity for grounding the secondary. Experience has shown, however, that no matter how carefully a lighting installation may be made, it is not possible to guarantee that the secondary circuit of a transformer shall always remain out of contact with the primary circuit. In primary circuits carried on overhead pole lines, there is always a certain risk of damage to the transformers from lightning. This risk can be minimized by the use of lightning arresters along the circuits, but cannot be entirely eliminated. If only for this reason, there is a possibility of the secondary circuit being brought into contact with the primary, within a damaged transformer. Again, accidental contacts occur at times, outside of the transformer, between primary and secondary leading-in wires.

As soon as, for any reason, a cross has been made between the primary and secondary circuits of a transformer, the condition may continue unsuspected for an indefinite period, if the secondary insulation is strong. If the secondary insulation is weak it may break down under the stress of the primary pressure, perhaps with arcing, and the danger of starting a fire. With a strong secondary insulation there may be no indication afforded of the high tension on the secondary circuit. Under such conditions a person standing on an iron register or on a damp cellar floor, has only to touch the exposed base of an incandescent lamp, in handling its socket for turning the lamp on or off, to receive a dangerous and possibly fatal shock. The danger is greater if a ground should exist on the primary circuit on the opposite side to that at which the accidental cross has occurred. If, however, the secondary circuit be properly grounded, as on water pipes, not only can no injury be done to the latter, but a dangerous cross between primary and secondary may be expected to blow the primary transformer fuses. At this day an ungrounded secondary system is as an achronism.

The Insulation of Insulators.

Commencing with the green bottle glass telegraph insulator, the size of a tea-cup, about ten years ago, the electric power-transmission engineers have been steadily increasing the size and cost of their high-tension insulators, until now they are using huge glass or porcelain insulators, the size of a cabbage. There has been no help for this visible swelling of the insulator. The little ones simply would not stand the electric stress, as the electric pressure rose by leaps and bounds. Even now the manufacturers would be ready to risk constructing transformers for one hundred kilovolts if the line engineers would accept that pressure. Perhaps the line engineers may do so before long. The question is what will their insulators then be? Will they be as large as umbrellas? Is long-distance transmission to be limited by the cost of conductors, or by the cost of insulators? A new suggestion is offered from Italy. Instead of placing the high-tension conductor on the top of the insulator, and arranging a series of porcelain petticoats beneath, so that a beetle would have to walk some 60 centimetres in the shortest path over the surface from wire to pin, the new insulator hangs the wire underneath the topmost petticoat which is expanded into a relatively thin umbrella. The purpose of the umbrella is only to shelter from rain and not to insulate; so that the umbrella can be made light and inexpensive. The actual insulator below the umbrella is stated to be considerably smaller than would be necessary if the umbrella were removed.

Electric Light and Telephone Country Service.

Every year of growth and development brings an increased accumulation of electric wires. In the cities this accumulation has been satisfactorily met by the use of underground conduits and cabled conductors. There is hardly any practical limit to underground extension in this way. This solution of the difficulty is, however, expensive, and can only be applied in densely populated areas, or city districts. In the country districts it is necessary to have all the wires overhead on pole supports. We need telegraph and telephone wires, which for practical purposes may be grouped together under the title of low-voltage signaling wires. We also need heavy electric traction wires or trolley feeders at 500 volts pressure, and electric light or power-distributing circuits at a pressure of 2,000 volts alternating, or more. The proper method is to place signaling wires on one side of the street and traction, lighting and power wires on the other side. Unfortunately, however, this is not always done and sometimes it is impracticable. Moreover, pole lines are unsightly objects, and spoil the appearance of a street unless erected in an expensively ornate manner, with graceful but costly iron poles. Consequently, a town council having granted permission to carry telephone wires on a pole line, often refuses an application from the electric light or power company to carry its wires on a separate pole line along the opposite side of the way. Both the signaling and the power transmission companies usually desire to keep apart, and would prefer to incur the extra expense of separate pole lines in order to keep clear of each other; but the residents object to duplicating pole lines and bring pressure upon their town governing body to deny such application. The council often orders both sets of wires to occupy the same poles. In many cases it does so in ignorance of the danger thereby involved.

Under ordinary conditions the danger of placing 2,000-volt distribution wires on the same poles as telephone wires is not serious, if the construction is good. There is, of course, a certain risk, but such conditions continue for years in some places, and no accident seems to occur. In order that an accident should happen to life, it is necessary that a wire should break and fall in such a manner as to bring a telephone wire into contact with a lighting wire; also that the insulation on the lighting wire should be abraded through at the point of contact. Further, there must be considerable leakage, or grounding, on the electric light circuit, and there must be a person in a house standing on a damp ground, or on a grounded metal frame, who takes up the

telephone connected to the high-potential cross. The person must also come in contact with the telephone wire either by touching the binding posts or by the presence of a fault in the wiring when he touches the telephone holder. If all these conditions occur simultaneously the person might receive a fatal electric shock. It is evident, however, that the probability of the concurrence of all these conditions is small. As a rule, the telephone protective apparatus would cut the telephone out of circuit shortly after the formation of a dangerous cross between the circuits. In practice the danger of shock faces the lineman more than the householder.

When the signaling and lighting wires must be carried on the same poles, the lighting wires should always be placed at the top, because they are almost always stouter, stronger and less liable to break than telephone wires. In a sleet storm telephone wires may be expected to break, not to speak of accidental fine weather fractures. If the 2,000-volt wires are on top the breaking of the telephone wires underneath will produce no trouble. Moreover, telephone and telegraph linemen will not have to work their way through high-tension wires when climbing a pole. It is worth while clearing the top cross arm and restringing its wires beneath, in order to make room for the electric light wires on top. It often happens that because the electric light wires go up last they are placed lowest, in order to avoid the inconvenience of restringing the wires on the topmost cross arm.

Another objection to the mingling of wires on the same pole line is the humming noise set up inductively in the telephones by the alternating-current lighting wires. The best way to minimize this disturbance is to place the lighting wires upon adjacent insulators or as close together as possible, and also to transpose them at intervals of not greater than a quarter of a mile. This transposition would be greatly facilitated if there were a good transposition insulator on the market for the purpose. There are satisfactory transposition insulators for telephone wires, but there appear to be none suitable for the larger and stronger lighting wires. Moreover, it should be possible to transpose or cross over such wires without cutting them at the insulator.

Let Your Actions Speak For You.

In the paper which was awarded the third prize in the Co-operative Electrical Development Association competition, printed elsewhere in this issue, Mr. Robb suggests a line of advertising under the head of "Let Electricity Do Your Work," to which all central station managers, officers and solicitors might well give heed. How many central station people have their residences and offices fully equipped with all the electrical appliances they are endeavoring to introduce? Until these things are tried by, and become necessities to, the central station men themselves, very little progress is apt to be made in their introduction in a community. It is true that the majority of progressive central station men have a number of the more common appliances, but few of them have gone into the matter in a way so thorough that they positively know from actual experience whereof they speak. In commercial as in other relations of life, evidence of good faith is a powerful adjunct in carrying out a purpose; and one solicited to put up an electric sign by an electric company which itself is signless, or asked to adopt in the household electrical appliances not used by the manager of the company, may well be excused for giving little credence to the claims presented in favor of what he may consider to be merely means of increasing the company's profit.

Interesting Innovations at Toledo.

A short article printed elsewhere in this issue, relating to changes and extensions under way by one of the central station companies of Toledo, Ohio, contains mention of two interesting innovations in central station practice. One of these is the adoption of 4,600 in place of the usual 2,300 volts for the general single-phase primary circuit distribution for lighting. The other is the abandonment of the plan of running a hot-water heating system with heat derived from the exhaust steam of an electric generating station, the heating system being entirely independent of the electric plant save that the hot-water circulating pumps are motor-driven. In regard to the use of 4,600 as against 2,300 volts for general distribution, it is the old question of cost of insulation vs. cost of copper. Insulators, fuses and transformers cost more for the higher voltage. In a village the size of wire with alternating currents is limited by mechanical strength rather than by conductivity, so there is nothing gained in cost of copper by using the higher voltage unless iron wire be used. In a large city a saving of 75 per cent in copper needed to keep within a certain voltage drop will pay for a good deal of extra insulation. The main points of weakness, however, in any system of this kind are the primary fuses and leading-in wires of the transformers. Equally high voltages for city distribution have been before employed, but so far as we know not under conditions comparable with those at Toledo as to size of system and multiplicity of moderate-sized transformers, there being about one transformer per block in the Toledo distribution system.

As to exhaust steam heating, we have evidently from Toledo another answer to the oft-asked question whether the use of exhaust steam for heating by a central station pays. The difficulty there as elsewhere was in phasing the heating and lighting loads. Of the abstract economy of selling the heat derived from the exhaust for continuous use, as compared with the economy gained by condensing there is little question; but in central station practice it is rare that the ideal conditions exist for achieving full economy. Many months of the year no heat is wanted; and where the average heating load may be about sufficient to utilize the average winter exhaust, the demand for heat may be considerably more than the exhaust can furnish on some cold winter mornings. Both of these conditions call for extra investment or increased operating expense, until a point may be reached where it is cheaper to generate current in an economical condensing plant the year round than to try to utilize a by-product a part of the year and operate an uneconomical generating plant the balance. These are conditions which are more likely to exist in large cities than in villages for the reason that economical locations for electrical generation in large cities are seldom economical centers for hot water or exhaust steam distribution.

The differences in the electric and heating load curves can be reduced to some extent by securing 12 and 24-hour power business, as has been done in a number of places where managers have found themselves with less all-day electric load than could take care of the heating, and have made strenuous efforts to build the electric load up to the heating load. There are two safe rules for those in the combination heating and electric central station business. One is that in taking on enough heating load to make any considerable use of live steam rates should be based on live steam rather than exhaust. The other is that if live steam is not to be used and live steam rates not charged, care should be taken that the heating load does not get above what can be taken care of with exhaust in average January weather all day, and every

day. These rules will avoid the painful predicament of central stations that have taken on too much heating load to be carried by the exhaust.

A curious form of contract for electric lighting service is in force with some central station customers in Toledo, Ohio. The customer names in advance when he signs his contract any amount he chooses as his minimum bill. The consumption up to the amount of the minimum bill is then paid for at 5 cents per kw-hour, and all in excess of the minimum bill is paid for at the rate of 8.1 cents, the latter being the maximum rate permitted by ordinance in Toledo. The plan is just the reverse of the two-rate system in common use, although not exactly the reverse in its practical effect. While it tends to make a customer pay cheerfully his share of fixed or readiness-to-serve charges, it discourages the long-hour use of current. The ordinary two-rate and readiness-to-serve methods force a customer to pay his share of the fixed charges and encourage the long-hour use of light and power by making a lower rate for it.

ELECTRIC SIGN ORDINANCES.

In a number of cities there have been movements to improve the general appearance of downtown streets by limiting the distance which signs may overhang sidewalks. While such ordinances have been usually considered hardships by central station companies pushing the sign business, as ordinarily drawn, they offer, however, no excuse for inactivity, as some of the best sign development in the country is in cities where such ordinances are in effect. The loss of value of an electric sign by confining it closely to a building rather than allowing it to project several feet is often overestimated. As a matter of fact, the majority of electric signs as they are at present constructed cannot be read over 250 ft., and many of them not over 100 ft. distant. This being the case, the value of a sign flat on a building is almost as great as that of an overhanging sign. The really big signs have to be placed against the building or on tops of buildings and in vacant lots. Taken altogether, we do not think central stations need have any feeling against municipal art leagues and the like which are attempting to limit the projection of overhanging signs. We do think, however, that the limits in some cities are made unnecessarily small.

Another aspect of the electric sign ordinance situation which has been mentioned at several conventions recently is the requirement that electric overhanging signs must be lighted a certain minimum number of hours each night. The theory upon which such ordinances are based is that if the property owner wishes to hang something over the street he must make a return to the city by assisting to improve the general cheerfulness of the downtown streets in the evening. Such ordinances are looked upon differently by different central station men. Some consider that they are on the whole a detriment to the best growth of the electric sign business, while others believe that they insure to a central station company the best class of sign business from a revenue standpoint. It is probably true that some merchants will not put up signs if they are obliged to turn them on every evening until 10 or 11 p.m. Where, however, the electric sign load extends to a late hour, it is much more desirable to a central station than where signs are turned on only when stores are open, and therefore at a time when the station load is heavy. The companies which are getting the best revenue from sign and display lighting are those which have encouraged signs that are lighted every night in the year rather than those turned on and off at the will of the owner.

HOW NOT TO ADVERTISE.

Central station managers are receiving many good suggestions these days from various sources as to the wording of advertisements to be used in pushing various devices. Most of these are good, but occasionally we see one which forces us to protest. In a suggested advertisement for electric irons recently published the disagreeable features of ironing day are very well brought out, but the reference is made to the "tremendous heat radiated by ordinary irons while in use," and the assertion is later made that the electric flat iron "does not radiate any heat." An advertisement which is so weak and defective technically as this is likely to do more harm than good among thinking people. In the first place, the actual amount of heat radiated from any kind of flat iron is very small, and any thinking man or woman would immediately question the value of an iron from which heat was not radiated. The fact of the matter is that it is not the heat from the irons themselves, but the waste heat from the stove that makes ironing day in summer a burden. As to the heat radiated from the irons themselves, there is very little difference between electric irons and any other kind. The strong point about the electric iron is that there need be no other heat in the room, and doors and windows can be kept wide open to let the wind blow through without fear of blowing out the gas or gasoline, if these are used. With a coal range, it is impossible to keep a room cool any way in hot weather. Then, too, the electric iron saves steps and time and does not need frequent cleaning, scraping and waxing. The electric iron has merit enough without attempting to introduce it with fallacious arguments.

DEFICIENCIES IN THE ELECTRIC HEATING FIELD.

So much is being said these days about electric cooking and heating devices and their introduction by central station companies, it will not be amiss to call attention to some little details which, until they are attended to, are sure to hamper the introduction of electric cooking and heating devices where a number are to be used in a household; or, in other words, where special heating circuits are necessary. It must be generally conceded in the first place that no very extensive use of electric cooking appliances will be made until special heating circuits are provided in houses. There are lamentably few houses with such circuits at the present time, and the details of wiring and fittings in connection therewith have been given insufficient attention by the manufacturers of heating appliances. In fact, it seems as if the difficulties of making the appliances themselves up until recently had been so great that but little attention had been given to getting current to them. Let the would-be user of electric heating appliances who intends to put in special circuits and do everything in accordance with underwriters' rules search the latest supplement to the National Code for a list of approved plugs and receptacles which will carry over three amperes and are suitable for use in a residence where the child with the hairpin is one of the factors to be reckoned with. To be sure, he finds several open or easily opened flush receptacles which have been approved for ten amperes. Beyond that there is nothing on the list, but we are glad to learn that this want will be filled within a short time. The whole subject of wiring for heating appliances is in a stage of development from which it should be released as soon as possible by the working out of acceptable fittings and plans of installation suitable for ordinary dwellings.

Patents and the Sherman Law.

A Federal Court decision of apparently great importance was recently rendered at Milwaukee, defining the status of patent monopoly. A corporation had obtained ownership of about 200 patents relating to threshing machinery, which manufacturers were permitted to use by the payment of royalty. One manufacturer refused to settle for royalties on the ground that the plaintiff corporation was a monopoly under the Sherman law, being a combination in restraint of trade and against public policy, and the case was taken to court. Judge Seaman in his opinion, which was adverse to the claim for royalty said: "I am of the opinion that the monopoly thus secured, to be immune from the anti-Trust act, must be referable solely to the invention under the patent, and that a combination of licenses formed thereunder may create a monopoly which exceeds the legitimate scope of the patent privilege, and is not within the contemplation of the provisions of the grant, and thus violates the general act referred to."

The Tungsten Lamp.

In view of the recent important and interesting announcement that the General Electric Company is going to manufacture tungsten incandescent lamps on an extensive scale and that its tungsten lamp consumes between 1 and 1¼ watts per candle it seems interesting to give in the following notes a concise review of what has been done in the past towards the development of this new lamp. While considerable detailed information concerning the tungsten lamp has already been published in our columns, especially in the Digest (see, for instance, Vol. 47, pages 354, 416, 487, 672, 833, 880, 984, 1019, 1040, 1194), a brief summary of the whole situation would seem to be opportune at this moment.

While tungsten is considered one of the rare elements, tungsten compounds are of considerable use. Sodium tungstate is largely employed for impregnating fibres to make them fireproof. It is also used as a mordant in dyeing. Tungsten bronzes are largely employed as bronze powders and pigments. The chief consumption of tungsten in recent years has been however, for high-speed tool steels and for hardened steel for armor plates and large guns.

It is mainly on account of the rapidly increasing use in the steel industry that the demand for tungsten has shown a remarkable advance since 1900, as is indicated by the following figures, taken from J. H. Pratt's Production of Steel-Hardening Metals in 1905 (publication of U. S. Geological Survey). 46 tons of tungsten concentrates were produced in this country in 1900, 179 tons in 1901, 184 in 1902, 292 in 1903, 740 in 1904, 803 in 1905.

The value per ton has also advanced, due to the greatly increased demand. According to Pratt, whereas formerly tungsten concentrates containing 60 per cent WO_3, were valued at from $2 to $3 per unit, they are now worth from $5 to $6 per unit, and it is not improbable that a price of $6 per unit may be maintained. The word unit here means 1 per cent of a ton. In spite of this advance of price, it will be seen that tungsten is a rare element not at all in the same sense as, for instance, platinum or osmium.

At the present time there is but one district in the United States that is being developed as a business proposition, and on a large scale, and that is the Boulder County, Colorado, district. There are, however, numerous localities throughout the United States where tungsten minerals have been found, but there are only a few thus far known that give promise of containing the metal in quantity. Only small quantities of ferrotungsten alloys or tungsten salts are imported into the United States, because at the present time the European markets utilize practically all of the tungsten that is produced in foreign localities, largely in Australia and Peru.

The melting point of pure tungsten has always been stated to be very high, though it does not seem to have ever been accurately determined. As a matter of fact, from experiments recently made with pure tungsten by Just and Hanaman (London *Electrician*, 1906, April 27) it appears that tungsten behaves like carbon, since (under ordinary conditions of pressure) it volatilizes directly without passing through the liquid state. But the temperature at which carbon volatilizes is considerably lower than that of tungsten. That means that a tungsten filament can be operated at a considerably higher temperature than a carbon filament, and from the thermodynamical laws of radiation, especially from the Stefan-Boltzmann law of total radiation and from Wien's displacement law, we can therefore conclude *a priori* that the tungsten lamp will be much more efficient than the carbon lamp.

In view of its well-known refractory nature, the use of tungsten for the filament of incandescent lamps early suggested itself, although the first attempts were rather to coat a carbon or platinum filament with a layer of tungsten. For the production of pure tungsten filaments different methods have been worked out in recent years, first by Dr. Alexander Just and Franz Hanaman, second by Dr. H. Kuzel, and third by the Welsbach Company, although by using the words "first," "second," "third" we do not mean to decide in any way questions of priority or superiority.

Like most metals proposed for incandescent lamp filaments, tungsten has a lower electric resistivity than carbon, and for this reason the manufacture of high-voltage tungsten lamps is more difficult than that of carbon lamps for the same voltage. The underlying reason of this difficulty is the same as with osmium and tantalum lamps, but from what will be said below it seems that in the main these difficulties in the manufacture of tungsten lamps have been successfully overcome.

To avoid any misunderstanding concerning the exact meaning of the figures given in this article, it should be said that with candle-power is always meant mean horizontal candle-power. Further, since the tests were made in Austria and Germany, the unit is the hefner candle, which was heretofore always assumed to equal 0.88 British or American cp. On this basis, when in the following, for instance, a consumption of 1 watt per candle-power is mentioned, it means 1 watt per mean horizontal hefner candle-power, which is equivalent to about 1.14 watt per British cp. From recent tests of the Reichsanstalt, dealt with in our issue of July 21, 1906 (page 115, and Digest, page 145), it appears, however, that the former usual conversion factor between hefner candle and British cp must be modified so as to make 1 hefner = 0.909 British cp or 1 cp = 1.1 hefner. On this basis a consumption of 1 watt per hefner candle is equivalent to 1.10 watt per British cp.

The German patent 154,262 of Just and Hanaman, of Vienna (April 15, 1903, granted Sept. 8, 1904), starts from the idea of producing a coating of tungsten on a core of carbon. The oxychlorides of tungsten or molybdenum, when heated to red heat, are reduced by hydrogen, forming metal, hydrochloric acid and water. If, therefore, a carbon or metallic filament is heated to incandescence in an atmosphere of tungsten oxychloride vapor with an excess of hydrogen, the reduced tungsten is deposited on the carbon or metallic filament, and the resulting filament consists of a core of carbon or metal, with a cover of tungsten.

Experiments proved, however, that under certain conditions the reaction proceeds in a different way. If a carbon filament is electrically heated in tungsten oxychloride vapor in presence of very little hydrogen, it is by and by transformed into a filament of pure tungsten. The carbon is oxidized to CO and CO_2, the chloride combines with the hydrogen and the tungsten is deposited in the place of the carbon.

When the carbon has been entirely replaced by tungsten, it is advantageous to increase the quantity of hydrogen and more tungsten is now deposited on the tungsten filament, hydrogen being the reducing agent, while carbon does not participate in the reaction.

The conditions under which the reaction occurs with the oxidation of carbon are an excess of oxychloride, the presence of very little hydrogen and a high temperature of the filament. With an excess of hydrogen and at too low a temperature of the filament, carbon does not participate in the reaction.

Exactly the same reactions take place with molybdenum instead of tungsten.

In the *Chemiker Zeitung* of July 28 Dr. E. R. Boehm points out that this method is entirely analogous to a method patented by Dr. Fritz Blau in 1901 for transforming a carbon filament into osmium in an atmosphere of osmium tetroxide.

The above method is called the substitution method. Some modifications of the same are mentioned in the English patent 11,949 of 1905, granted to Just and Hanaman. When a carbon filament which is provided with a coating of tungsten of sufficient thickness is submitted in vacuo to an adequate temperature by passing an electric current through it, the carbon combines with the metal surrounding it and a carbide is formed. the whole filament now becoming homogeneous. This process, which may be termed "dissolving" the carbon, occupies but a few minutes, and takes place the more speedily the greater the excess of metal over carbon. In order to first produce the tungsten coating on the carbon, carbon filaments of the greatest possible fineness (of a diameter of, say, from 0.02 to 0.06 mm. or 0.8 to 2.3 mils) are submitted to the action of an electric current in an atmosphere of tungsten hexachloride $W\,Cl_6$ in the presence of hydrogen or of some other gas exercising a reducing action, whereby the tungsten is deposited upon the surface of the carbon. When the tungsten coating is of sufficient thickness, the filament is brought to incandescence by an electric current in an atmosphere of a very highly rarefied inert gas, such as hydrogen, at a pressure of 20 mm. The solving process, above described, then takes place and is completed in a few minutes. The filament thus obtained contains the carbon in a bound form (mostly as carbide) and presents a glittering white appearance.

The filament is once more raised to a high temperature by an electric current in a mixture of steam with reducing gases, and the carbon is oxidized by an action similar to that which takes place in the manufacture of water gas. (This, as may be remarked here, is exactly the same reaction by which the carbon due to the organic binding materials is removed from the osmium in the manufacture of the osmium lamp.) Another method of decarburizing described is as follows: The tungsten-carbide filaments are embedded in a refractory crucible, which is then carefully luted, in a very finely pulverized low oxide of tungsten, as WO_3 and then heated to a temperature of about 1600° C. for several hours. By this process the carbon is oxidized according to the equation $WO_2 + 2\,C = W + 2\,CO$. The reduced tungsten does not become deposited upon the filament, but remains in the oxide mass surrounding the filament as an amorphous powder.

Besides these substitution methods, an entirely different process has been patented by Just. It is called the paste method, and is analogous to Auer von Welsbach's method of making osmium filaments. Tungsten compounds, reducible by hydrogen (like oxide, sulphide, chloride, etc.), are powdered and mixed with a binding material free from carbon (such as water) formed into a paste, pressed into filament shape and reduced in an atmosphere of hydrogen.

It seems, however, that some substitution method is now used in practice for making tungsten lamps. The development of the tungsten lamp by the methods of Just and Hanaman took place in the lamp works of the Vereinigte Elektrizitäts A. G. in Ujpest, which owns the licenses for Austria and Hungary. Russia, Belgium, Italy, Spain and Portugal. The German patents are owned by the Wolfram A. G. in Augsburg, which have transferred the monopoly of manufacture to Georg Lüdecke & Co. in Lechhausen.

According to a statement of the Vereinigte Elektrizitäts A. G. the substitution method of Just and Hanaman permits the manufacture of very thin filaments of pure tungsten, whereby it becomes possible to make 110-volt lamps for relatively small candle-power, like 32 cp. It is stated that filaments with such a small diameter cannot be made by the paste process. In the 110-volt, 32-cp tungsten lamp of Just and Hanaman there are three exceedingly thin filaments of pure tungsten, the filaments being held in place by suitable stays of aluminum oxide or of a mixture of other suitable oxides. In size and form the new lamp is stated to be almost identical with the ordinary 110-volt, 32-cp carbon filament lamp.[1]

Concerning the results obtained with the Just-Hanaman tungsten lamp, no exact information is yet available. But the statement is made—apparently on the authority of the manufacturers—that the average life of a 110-volt, 40-cp lamp when consuming one watt per hefner candle is 1,500 hours. It is also claimed that the illuminating power of the lamp remains almost unaltered during its entire life, and that it is not at all sensitive to fluctuations in the supply pressure.

Another type of tungsten lamp has been developed by Dr. H. Kuzel, of Vienna, whose invention is based on two new essential features as pointed out by himself in a communication to *Elektrotechnische Zeitschrift*, of May 10, 1906. One point is the establishment of the fact that metals in the colloidal condition form plastic masses without the addition of a binding material and can be formed easily into colloidal wires. The second point is that wires formed in this way and dried undergo a physical change when subjected to strong heat; without breaking or disintegrating into powder they pass over from the colloidal state into the crystalline condition and the lamp filament is thereby finished. Dr. Kuzel claims that he can use this method for bringing a great many metals into filament form. In his patent he mentions fourteen, among them tungsten.

But this is not all. Dr. Kuzel is reported to favor alloys instead of pure metals, though the published information is extremely vague. If that material is most suitable for an incandescent lamp filament which has the highest melting point, it would seem *a priori* that a pure metal must be used. For it is a general rule, based on sound thermodynamics, that the addition of any impurity to a pure material lowers its melting point. (This is true under the condition that in the freezing liquid none of the foreign substance pass into the solid phase.) For this reason any first admixture of a foreign material to a pure metal filament like tungsten will necessitate operating it at a lower temperature. It is just for this reason that in the steel industry when we want to add chromium or tungsten or so to the molten bath, we add it in form of a ferro-alloy because this has a lower melting point than the pure metal. But the requirements of incandescent lighting are the reverse and for this reason it has been an axiom in the past that pure elements must be employed for filaments and much of the extended chemical research work which has been done in lamp factories was carried out for the purpose of devising methods of purification.

However, while it is true that the first addition of impurity (under the limiting condition given above) lowers the melting point of a pure substance, it does not follow that an alloy must always have a melting point lower than its constituents when pure. If the melting-point curve of two metals, A and B, is plotted in the usual way as function of the ratio of A to B, it will be found that the curve drops at both ends, i. e., the melting point is lowered if a little of the metal, B, is added to pure A, or if a little of the metal, A, is added to pure B. But there are cases known where the curve looks like this: Beginning at the left hand (pure A), the curve first drops, reaches a minimum, goes up again to a singular point which we may call C, drops again, reaches a minimum and rises again to pure B. And there are cases known when the melting point of the alloy corresponding to point C is higher than that of the pure metals, A and B. It is possible that Kuzel wants to use such alloys for filaments, though it is not clearly stated. Moreover, it is quite possible that the importance of a high melting point has been overestimated in the past, and that other physical properties (for instance, electric conductivity, etc.) are of greater importance for the construction of filaments.

The German patents of Kuzel are owned by Pintsch Brothers in Berlin, while in Austria the firm of Kremenecki in Vienna has already made Kuzel lamps. Results of tests of the same were given on page 354 of our last volume (February 17, 1906). They show a power consumption of about one watt per hefner candle, but the hope was expressed by the manufacturer that it might be reduced in future to one-half watt per hefner candle with a useful life of 1,000 to 1,500 hours. Nothing whatever was stated concerning the material of the filament.

[1] It is stated at present that this company will select the 40-hefner candle (35.2-cp) 40-watt, 110-volt lamp as standard type. A full-size view of this lamp is given in the Trade Section of our present issue.

Finally the work of the Austrian Welsbach Company must be mentioned. While very little information has been given out by them, they were among the first to place tungsten lamps on the market for voltages of 100 to 120 and consuming one watt per hefner candle. Their lamps have been tested in the testing laboratories of the Municipal Electricity Works of Vienna. The above figure for power consumption was confirmed and while the tests were not yet completed when referred to by Mr. Ross in a lecture before the Austrian Association of Electricity Works, the results obtained up to 1,000 hours of burning were said to be favorable. The hall in which this lecture was held was lighted with Welsbach tungsten lamps of 60 to 80 cp, giving a light which was specially pleasant by its beautiful white color. That these lamps are not sensitive to variations of voltage and can stand considerable overload, was shown by the lecturer, who operated one of the lamps at double the normal voltage. The only information on the Welsbach Company's method of making the filaments is that they treat the trioxide of tungsten with an excess of ammonia so as to form a tough paste and work this into filaments.

Quite recently the announcement has been made by the Welsbach Company that during the next season they will place on the market modifications of their osmium lamp, for which they use the trade names "osmin" lamp and "osram" lamp. They are employed at higher voltages than the osmium lamp and are stated to have a much higher efficiency. According to Dr. C. R. Boehm (*Chemiker Zeitung*, July 28), the chief constituent of the filament of these new lamps is tungsten. The name osram is derived from osmium and wolfram (the German name for tungsten). Thus it seems that the Welsbach Company, like Kuzel, undertakes the employment of alloys for filaments.

25-cp and 32-cp "osram" lamps have been officially tested by the German Reichsanstalt (*Elektrotechnische Zeitschrift*, August 9, 1906), alternating current from the supply network of the Charlottenburg municipal electricity works being used for testing. The osram lamp consumes about 1 watt per hefner candle, the average life being 1,000 hours; during this life the loss of candle-power is almost insignificant, as will be seen from the following figures of the Reichsanstalt for "25-cp" osram lamps (which are, of course, more difficult to build than osram lamps for higher candle-power and the same voltage). The average alternating-current voltage was 117; the mean horizontal candle-power 28.5; the consumption 1.11 watt per candle-power at the beginning. After 200 hours the corresponding figures were 29.8 and 1.06, after 500 hours 28.1 and 1.12, and after 1,000 hours 26.6 and 1.18. These are the mean values for the whole set of lamps tested. The best lamp of the set gave 27.3 cp and consumed 1.10 watt per candle-power after 1,000 hours; the worst lamp gave 25.7 cp and consumed 1.22 watt per candle-power.

This is the first official test of any type of tungsten lamp which has been made public and it should be again emphasized that these tests were made with alternating current. It is claimed for the tungsten lamp in general that it works as well with alternating current as with direct current, but in the absence of official tests of other types of tungsten lamps it is necessary to be somewhat cautious in accepting such claims in view of the experience with the tantalum lamp.

From the above summary of the development of the tungsten lamp in Europe it will be seen that it took place almost exclusively in Austria. This is probably to be attributed to the strong influence of Dr. Auer Ritter von Welsbach, this remarkable chemical engineer whose work has been of such immense importance in creating the methods of modern illumination, both in gas and electric lighting.

The Westinghouse Company has not yet made any announcement as to tungsten lamps, but is understood to have control of one of the best of those brought out in Europe. Elsewhere in these pages, under "Current News and Notes," is an item in which the Teter-Heany Developing Company, of York, Pa., makes a statement as to the work and claims of its engineer, Mr. J. Allen Heany, who is known to have been working in the line of tungsten filaments for the past two or three years, although none of his patents have issued yet, nor has any account of his inventions or researches been given out by himself or his associates.

A Decision on the General Electric-Westinghouse Compact.

A very interesting decision of the Circuit Court of the Northern District of New York, of April 4, 1906, has just been made public, in regard to a dispute between the General Electric Company and the Westinghouse Electric & Manufacturing Company as to the meaning and validity of some of the terms in their famous agreement of ten years ago. The decision was handed down by Judge Ray. The contract of March 31, 1896, contains the following clauses:

"The Westinghouse Company shall not manufacture, for use in the United States, as hereinafter provided, electric brakes or the 'K² Series-Parallel Controller' or any series-parallel controller of the general type of the 'K² Series-Parallel Controller' (and other similar controllers now being manufactured by the General Company, such as controllers of the types now designated as K, L, BA and S, respectively), or operating upon the same general principles irrespective of its form and the details of its structure or operation, or any controller involving a blow-out device. The General Company shall sell and deliver to the Westinghouse Company, with reasonable business promptness, such controllers and electric brakes, as it shall, from time to time, order, at the lowest prices at which it sells the same to others less a discount of thirty (30) per cent in the case of controllers and twenty (20) per cent in the case of brakes, but in no case shall such discount to the Westinghouse Company exceed one-half of the difference between such lowest price and manufacturing cost.

"The Westinghouse Company shall sell the K² Series-Parallel Controller and other series-parallel controllers of the same general type or operating upon the same general principles, and controllers involving the use of a blow-out apparatus, and electric brakes, manufactured by the General Company, to the exclusion of all other controllers of the same general type and operating upon the same general principles, and of all other electric brakes, and the General Company shall likewise sell the overhead trolleys manufactured by the Westinghouse Company, to the exclusion of all other overhead trolleys.

"In case the General Company shall refuse to furnish the Westinghouse Company with any series-parallel controllers or any electric brakes, or shall fail to deliver the same with reasonable business promptness, or if in any instance the controllers or electric brakes offered by the General Company are not adapted to the purpose for which they are required by the Westinghouse Company, the Westinghouse Company may manufacture such series-parallel controllers or electric brakes to such extent as, and so long as, the General Company shall have refused or failed to furnish the same, or to such extent as and so long as the controllers or electric brakes offered by the General Company are not adapted to the purpose for which they are required by the Westinghouse Company.

"In case the General Company shall manufacture and sell any overhead trolleys in violation of this agreement, or the Westinghouse Company any series-parallel controllers or electric brakes in violation of this agreement, then the party so manufacturing and selling such overhead trolleys, controllers or brakes, as the case may be, shall pay to the other party, as liquidated damages and not as a penalty, fifty (50) per cent of the price at which such overhead trolleys, controllers or brakes, as the case may be, are, at the time, being regularly sold to users by the party entitled under this agreement to the exclusive manufacture of the same.

"The provisions of this section shall apply to parts of controllers, electric brakes and overhead trolleys as well as to the complete devices.

"The General Company shall comply with the reasonable directions of the Westinghouse Company in respect to the marking (except as to the numbers of the patents under which the device is manufactured) of all controllers and electric brakes and parts thereof ordered by the Westinghouse Company.

"All annual periods provided for in this agreement shall be computed with reference to the first day of May, 1896, and this agreement shall terminate fifteen years from the said first day of May, 1896."

Violation of this contract by the Westinghouse Company was alleged, and relief was sought in the shape of an injunction restraining further violation, for an accounting as to sale of said controllers and for a judgment for the amount of damages ascertained. The court has ruled that there are no facts stated entitling the complainant to equitable relief. Subjoined is an official synopsis of the decision:

1. Specific Performance—Contracts—Manufacture and Sale of Specific Articles—Continuing Contracts.

A contract to remain in force for 15 years provided that defendant should not manufacture certain electric controllers for use in the United States; that complainant would sell and deliver such controllers to defendant at specified prices; that defendant would sell them to the exclusion of all others of the same kind, and that complainant would sell defendant's overhead trolleys to the exclusion of all others; and that if complainant failed to supply defendant with controllers pursuant to contract, defendant might manufacture them. *Held,* that it was not a contract of which equity would compel specific performance.

2. Injunction—Mutuality of Remedy.

There being no mutuality of remedy, complainant could not, in effect, enforce specific performance by an injunction restraining defendant from making and selling similar controllers in violation of its agreement.

3. Same—Adequate Remedy at Law.

Where a contract for the manufacture and sale of electric equipment provided that in case either party violated the same, it should pay as liquidated damages and not as a penalty 50 per cent of the price at which the appliances referred to were at the time being regularly sold to users, performance at all events was not contemplated by the parties, and complainant was not entitled to an injunction to restrain defendant's violation of the contract, on the ground that complainant had no adequate remedy at law.

4. Same—Accounting—Discovery.

Where a contract for the manufacture and sale of electrical appliances provided that in case of violation, the party guilty should pay the other as liquidated damages 50 per cent of the price at which the appliance in question was being regularly sold at the time, an injunction restraining the violation of such contract could not be allowed for the reason that the damages were difficult of ascertainment, complainant being entitled to a discovery of sales made by defendant, in violation of the agreement in an action at law, as authorized by Rev. St. U. S. § 724 (U. S. Comp. St. 1901, p. 583).

5. Courts—Federal Courts—Practice—Demurrer—Conclusions of Law.

The rule that a demurrer does not admit legal conclusions pleaded obtains in the federal courts.

6. Injunction—Grounds—Multiplicity of Suits.

Where a contract bound defendant not to manufacture certain electrical controllers except on complainant's failure to furnish similar controllers at certain prices, and declared that in case of violation thereof defendant should pay as liquidated damages and not as a penalty 50 per cent of the price at which such controllers at the time were being regularly sold to users, complainant was not entitled to an injunction to restrain a violation of such contract, in order to avoid a multiplicity of actions at law for damages.

The case was argued by Mr. Hinsdill Parsons for the complainant (Lewis Carr of counsel), and Guthrie, Cravath & Henderson (W. D. Guthrie of counsel) for defendant.

Illumination at the Eagles' Convention, Milwaukee.

The illumination of the business streets of Milwaukee during the recent Eagles' convention in that city, as carried out by the lighting department of the Milwaukee Electric Railway and Light Company, proved to be one of the best and most satisfactory plans of street decoration ever tried there. The results produced were excellent from a decorative standpoint, while the construction was simple and substantial. The general plan was to place an arch of lights across the street above each railway span wire, as indicated in Fig. 1. This arch of lights was suspended from a span wire above the regular trolley span wire. The arch consisted simply of the two supply wires from which the lamps were fed. These supply wires were supported by porcelain insulation of the type which take two conductors side by side as shown in Fig. 2. These insulators were held together by an eye-bolt to which the wire was attached, by which it was hung from the span wire. The lamp sockets were of the type commonly used in such decorative lighting and were supported by the two conducting wires. Lamps were placed about one foot apart. On the central part of the arch clear bulb lamps were used, and on the ends red and green bulbs. In some cases the steel poles were not high enough on one side of the street to take the extra span wire, and in these cases a neat wooden extension was driven in the top of the steel pole. Although the plan is best suited to temporary lighting it is substantial enough so that it could be made to serve well as a permanent down town lighting scheme in small villages where some special lighting is wanted and steel arches are prohibitive in cost.

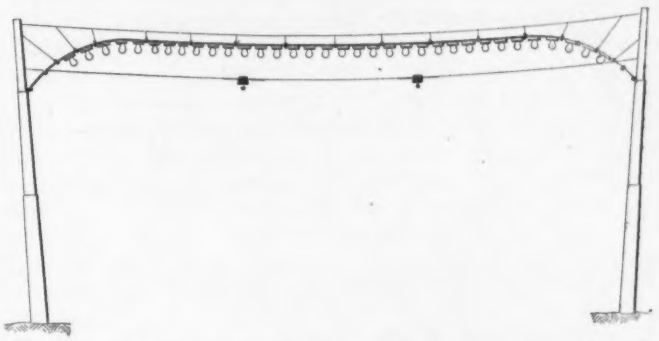


FIG. 1.—GENERAL PLAN OF TEMPORARY STREET DECORATIVE LIGHTING, MILWAUKEE.

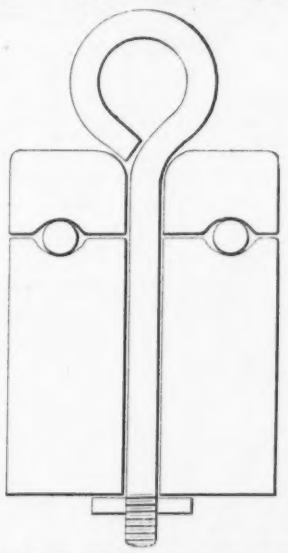


FIG. 2.—PLAN OF SUPPORTING WIRES ON ARCH.

Electrical Contractors Inspect Brooklyn Edison Power Houses.

The electrical contractors of Brooklyn made an inspection of the power houses of the Edison Electric Illuminating Company, of Brooklyn, on Thursday afternoon, August 23. The lighting company is making extensive additions to its power plants, and in order that the Brooklyn contractors might acquaint themselves with what was being done in this direction, the company arranged an automobile trip to the two stations, followed by a supper at Luna Park, Coney Island, where the company does so much summer lighting.

The generating stations of the Brooklyn Edison Company are located at the foot of Gold Street and at the foot of Sixty-sixth Street. Over two and one-half millions of dollars is being ex-

pended on the Gold Street station, which is being entirely rebuilt. Steam turbines will be used exclusively as prime-movers and the ultimate capacity of the station will be 85,000 kw. During the past three years over three-quarters of a million dollars has been spent in improvements and additions to the Bay Ridge station at Sixty-sixth Street, the total capacity of which exceeds 14,000 kw. The electricity from these two stations is delivered to 14 sub-stations of the company scattered throughout the borough, six of which are provided with storage batteries. The connected load on the company's lines on August 1, 1906, equalled an equivalent of 1,052,389 16-cp lamps, in addition to which uncompleted installations had been contracted for exceeding 75,000 equivalents. The distribution equipment of the company includes 556 miles of underground cable and 1,327 miles of overhead wires. The increase in equivalent 16-cp lamps for the first seven months of 1906 was 270,539, while for a similar period of 1905 the increase was 160,296 equivalent 16-cp lamps.

The company proposes to spend $100,000 yearly in getting new customers and educating the public in the uses of electricity, and it is hoped and believed that the contractors would see the possibilities in their particular field which awaited development and which were mutually beneficial to the contractor and to the electric light company.

The Convention of the Ohio Electric Light Association.

The Ohio Electric Light Association held its twelfth annual convention at Put-In-Bay, Ohio, August 21, 22 and 23. The excessively hot weather considerably interfered with convention work, and though many valuable papers were presented, the discussions were very brief. The first session was called to order Tuesday afternoon, August 21, by Secretary D. L. Gaskill, of Greenville. Mr. Gaskill explained that owing to the fact that the president, Mr. Valentine, had left the state and was no longer connected with a central station company, it became necessary for Mr. W. E. Russell, vice-president, to take the executive office. The duties of president had recently been performed by Mr. Russell, who would preside at the sessions.

Mr. Russell then took the chair and delivered the president's address. In this he mentioned the fact that prices for street and commercial lighting had a gradual trend downward, mainly on account of natural gas competition. He suggested the establishment by the association of a kind of referendum board to which problems troubling its members could be referred and members would be at liberty to ask for various information needed. He urged that every plant make a start in determining and analyzing its production costs and the costs of serving different classes of consumers. If a company analyzed these matters thoroughly, it would have a much easier time convincing the sane and reasonable members of city councils that the rates charged were fair. He called attention to the fact that at the present time there is some uncertainty as to the proper legal form of making contracts for street lighting in Ohio and that the precautions to be observed in making such contracts are not agreed upon by various legal authorities. He then reviewed at length the Columbus rate decision case, which is one of the most important decisions for electric lighting companies that has been handed down for a long time. This decision was summarized in the Electrical World of June 16, 1906, page 1242, and was commented upon editorially in the issue of August 18, page 313.

Papers on "The Progress of High Efficiency Lighting Units in Ohio" were read by the following central station men: A. N. Cope, of the Public Service Company, Columbus, Ohio; T. D. Buckwell and J. W. Gilmartin, of the Toledo Railways & Light Company, and C. C. Collins, of the Columbus Railway & Light Company. Mr. F. W. Willcox, of the General Electric Company, read a paper on "New Lamps and New Opportunities." In connection with his paper he called attention to the recent announcement that the General Electric Company is perfecting a tungsten lamp of 1¼ watts per candle. Mr. Max Harris, of the Nernst Lamp Company, read a paper entitled, "Some Notes on High Efficiency Units by the Manufacturers." The convention then adjourned to the bathing beach, which was a very popular resort during the entire period of the convention.

A series of papers on "The Best Methods of Increasing Business" were then presented. Mr. Samuel M. Rust, of the Greenville Electric Light & Power Company, took up the subject as applied to small cities and towns. Mr. W. C. Anderson, of the Canton Light, Heat & Power Company, presented, but was not present to read, a paper on the same subject as applied to cities, and Mr. Frank M. Tait, of Dayton, discussed the subject as applied to large cities. Mr. Tait's paper was accompanied by recent copies of *Dayton Electricity*, which is the central station publication of the Dayton Lighting Company.

Mr. J. Robert Crouse addressed the meeting briefly on the work of the Co-operative Electrical Development Association in getting electricity advertised and pushed more extensively than heretofore. The substance of Mr. Crouse's remarks was similar to those made at other electric light conventions recently. He explained that the movement had its beginning in the discovery by incandescent lamp manufacturers that the rate of increase in incandescent lamp sales was falling off, thus indicating that the central station business was not growing as it should. Other manufacturers were interested in the movement and a campaign was begun to interest central stations in the more active pushing of their product and the offering to central stations of facilities for so doing. After Mr. Crouse's remarks it was voted to appoint a committee of two, one to be a representative of a purely electric central station company and one a representative of a gas and electric company, to confer with the Co-operative Electrical Development Association.

Another symposium on "Successful Ways of Increasing Business" was then taken up. This symposium was contributed to by Mr. J. Kermode, of the Cleveland Electric Illuminating Company; J. H. Maxon, of the Gallipolis Gas & Coke Company; D. W. Low, of the Alliance Gas & Electric Company, and M. E. Turner, of the Cleveland Electric Illuminating Company. The latter gave a very valuable schedule made up by the Cleveland company to cover cost of residence wiring under many varying conditions for use in that company's installment payment plan of residence wiring.

Wednesday afternoon the discussion of papers presented the previous afternoon was taken up and occupied about half of this session. Mr. William Wolls, of the Columbus Railway & Light Company then read a paper on "Gas Engines in Competition with Electric Motors," showing why electric motors could frequently be installed to displace gas engines. Mr. Charles A. Parker, of the Curtis Advertising Company, Detroit, Mich., read a paper on "Advertising and New Business Getting." Mr. J. R. Cravath, western editor of the Electrical World, presented a paper on "Wiring and Lighting Equipment of a $3,500-Residence Scientifically Lighted." He also gave at the close of his paper, at the request of President Russell, some points on church lighting, and showed a type of fixture he had recently designed which was artistic in appearance, and at the same time prevented light from shining in the eyes of persons in the audience, thus overcoming one of the greatest difficulties in church lighting.

Mr. B. S. Young, acting as chairman of the publicity committee, introduced a resolution protesting against the action of the Toledo Car Association (the steam road freight association) in decreasing the time allowed before the beginning of demurrage charges on freight cars held for unloading. This resolution was carried. A resolution relative to confiscation by railroads of coal consigned to public service corporations was referred to the executive committee. This session then adjourned.

Thursday morning the chair announced the appointment of Mr. Frank M. Tait, of the Dayton Lighting Company, and Mr. D. W. Low, of the Alliance Gas & Electric Company, as a committee to represent the association in the Co-operative Electrical Development Association. The nominating committee, consisting of Messrs. S. M. Rust, J. A. Maxon and W. J. Hanley, reported its recommendations, and officers were elected as follows: President, Mr. W. P. Engle, president of the People's Gas & Electric Company, Defiance, Ohio; vice-president, Mr. C. C. Collins, Columbus Railway & Light Company; secretary

and treasurer, Mr. D. L. Gaskill, president of Greenville Electric Light & Power Company. Executive committee, Messrs. W. E. Russell, of Massillon; M. E. Turner, of Cleveland; D. W. Low, of Alliance; E. H. Beil, of Youngstown, and F. M. Tait, of Dayton. Finance committee, Messrs. E. J. Bechtel, of Toledo; B. S. Young, of Ada, and J. H. Maxon, of Gallipolis. Advisory committee, Messrs. Samuel Scovil, of Cleveland; W. E. Miller, of Mt. Gilead, and D. L. Gaskill, of Greenville. Discussion of the papers by Messrs. Wolls and Cravath presented the day before, was then taken up briefly.

Mr. N. R. Birge, of the General Electric Company, read a paper on "Series Luminous Arc Rectifier Systems." This paper is the first published description of the magnetite arc lamp in its present form. He took up also the other elements of the new system. This paper was discussed as soon as read and much interest was manifested, many questions being asked as to cost and performance of various elements of the system.

Secretary D. L. Gaskill presented a report summarizing the bills that had been presented in the Ohio Legislature relative to electric lighting companies. This report was discussed at length in an informal way. A report of the committee on cost of determination, of which Mr. E. J. Bechtel, of the Toledo Railways & Light Company is chairman, was made, this report being mainly in the nature of a supplement to the report of last year. It also reviewed the Columbus rate regulation decision referred to in the president's address and gave some insight into the large amount of inquiry and expert testimony that had been taken in connection with this case. This report was discussed at length and some additional discussion was added of the new business papers presented the day before.

Mr. T. E. Crawford, manager of the Library Bureau, at Cleveland, O., presented a suggested standard form of report which he had prepared at the request of the officers of the association, and which drew out considerable discussion.

Mr. H. J. Mauger presented a paper on the latest commercial development of electric heating devices, which described the construction of General Electric heating apparatus more fully than has yet been done. He also gave informally a number of little practical points in connection with these devices which were of considerable value. He did not recommend the sale of complete cooking outfits in any town until the central station people were themselves acquainted with these outfits by actual use in their own homes. President Engle then made a few remarks and a vote of thanks was passed to the donors of the fine list of prizes which were offered in the various contests with which the ladies were amusing themselves while the gentlemen were in convention. It was voted to appoint next year a reporter of the progress of high-efficiency lighting units and electric heating and cooking devices. The convention then adjourned.

PRIZES FOR THE LADIES.—The prizes offered to the ladies attending the convention in the various contests arranged for their entertainment in themselves constituted a large exhibit. Following is a list of the prizes and donors: Electric breakfast set consisting of chafing dish, cereal cooker and coffee percolator, donated by General Electric Company; one alternating fan, Westinghouse Electric & Manufacturing Company; one piece cut glass, Libby Glass Works; one electric flatiron, W. J. Barr Electric Manufacturing Company; one curling iron, the W. G. Nagel Electric Company; one French coffee urn, Electric Appliance Company; one oscillating fan, the Robbins & Myers Company; one electric water heater, the Fisher Electric Company; one electric flatiron, American Electric Heater Company; one electric stand lamp, Post-Glover Electric Company; one alternating fan, Westinghouse Electric & Manufacturing Company; one electric flatiron, Cleveland Electrical Supply Company; one heating pad, General Electric Company; one stand lamp, Moreau Gas Fixture Manufacturing Company; one desk fan, the Star Electric Company; one desk fan, the F. Bissell Company; one electric flatiron, the Erner Electric Company; one drop-head sewing machine motor, Doubleday-Hill Electric Company; one revolving electric fan, Ft. Wayne Electric Works; one glass dome donated by Cleveland Window Glass Company; one disc stove, General Electric Company.

PAPERS AND DISCUSSIONS.

Below are given abstracts of some papers presented before the convention on business-getting methods, except that of Mr. Frank M. Tait, which discussed the question from the standpoint of the large city power plant, and a paper on advertising by Mr. C. A. Parker. Following is the discussion on the paper by Mr. Cravath, printed elsewhere in this issue.

DISCUSSION ON THE LIGHTING OF A $3,500 RESIDENCE.

Mr. Turner took issue with Mr. Cravath on the efficiency of the electric portable stand lamp for reading purposes. He thought the trouble with many such lamps was that they were too deep to spread the light over a wide area. With a stand lamp four or five people could read around a table; one of the best forms of stand lamp is the converted oil lamp. Table lamps are very popular.

Mr. Cravath said that this was partly a question of personal preference and partly a question of fact. The facts were that with any of the portable stand lamps obtainable the foot-candle intensity of light within an ordinary comfortable reading area was less with the stand lamp than with a properly equipped chandelier reading lamp. This could easily be determined either by calculation or trial. He thought that one thing which had brought discredit upon electric light in residences was the unsatisfactory reading light obtained from electric table lamps. He agreed with Mr. Turner that the converted oil lamp was one of the best table lamps, but the properly equipped chandelier lamp was better yet. Mr. Scovil said that he thought that the principal trouble with electric light for reading in many Cleveland residences was the placing of the lamps near the ceiling with all sorts of fancy obstructing glassware, so that it is impossible for a person to read by the light obtained from it, even if his eyesight is perfect.

The question of the best placing of meters, whether on the third floor, in the basement or in the kitchen, was brought up. Mr. Kermode said that the practice at Cleveland was to place the meters in the basement so as to avoid the annoyance of having meter readers go through the house in muddy weather and also save the meter reader's time. Iron pipe conduit was run from an entrance hole in the basement wall up to about 12 ft. above the ground, where the line wires entered the conduit. This plan was more expensive than placing it in the attic. It was better than placing the service switch in the attic and bringing the wire down inside the house, as the latter gave opportunities for a theft of current by taps between the service switch and meters. Mr. Inman, who had adopted the latter plan in Warren, said that one case of such theft had been discovered by him.

INCREASING BUSINESS IN A VILLAGE OR A SMALL CITY.

Mr. Samuel Rust, of Greenville, Ohio, took up the subject of increasing business in a village where the population is stationary. In the first place, good service must be given and in order to do this, the superintendent must have reliable men who take pride in their work and who are courteous at all times to customers. Central stations should take care of all construction work, such as wiring, for customers, or at least the company should see to it that the contractor does not charge prices that will tend to prevent houses from being wired. A company should use nothing but the best material and workmanship and install wiring at nearly cost. It is far better never to secure a customer than to get him and lose him, because he believes you have misrepresented something. Every central station should furnish free lamp renewals, no matter how small the town. It has a pleasing effect on the customer and is a paying business for the company, for the reason that if a customer is compelled to pay for his renewals he will take lamps from places that are little used, leaving the sockets open. This means loss of revenue to the company and a customer who is dissatisfied, because he has to use some other kind of light.

A successful superintendent in a small town must be with his men as much as possible and know that the work along every line of business is being done in the best and most

economical way. He should make a study of his customers, know their peculiarities and see that they are taken care of in a way that will satisfy each individual. Every company should give day service whether there is any actual profit in the day light operation or not, as such service popularizes electric lighting and makes it possible to put in small day load devices, which are fully appreciated by customers. With day current, flatirons can be made to prove a profitable investment—not supplied free (because what costs nothing is usually but little appreciated), but at actual cost and installed without further expense than for the iron. It is a good plan to install them on trial and say nothing about price or cost until customers have had a chance to get acquainted with their use. Where irons are furnished at cost, it will be found that less than 5 per cent will come back to the plant when the time comes to close the contract or remove the iron. One hard problem in pushing residence business has been the first cost of wiring in houses already occupied. While Mr. Rust had not tried collecting for wiring in instalments, he believed that such an inducement would be profitable. He believed that if companies would advertise a nice portable lamp free as an inducement to have houses wired during certain months, it would bring in much more than the cost of the lamps.

With business houses he found that furnishing the newest and best method of lighting is an inducement that is always good. In his plant they would have lost three very desirable department store customers had they not been able to please them with one of the new high efficiency lamps. The customers pay for the first installation, but lamp renewals are furnished under contract. No matter how small the town or how unprogressive the business man, if he sees his competitors well lighted and drawing custom for that reason, he will listen to inducements as to his own lighting. The primary cause of many plants not proving a financial success is the system of selling current on a flat-rate basis. At Greenville, a city of 7,000 people, not a single customer was lost in changing over to meter rates. The company went into the question of cost of production and fixed expenses very thoroughly to arrive at the best price it could give the consumer. It then went to the customers giving them the reasons for the change and courteously, but firmly, informed them that the flat-rate system was to be a thing of the past. No attempt was made to withhold anything from the customer, and the whole matter was dealt with in a heart-to-heart business talk on the injustice of a flat-rate system and the necessity for a meter rate which would be fair to both parties to the contract. Customers were given the option of current at a 9c rate or a two-rate system with a fixed charge of $3 per kw per month and current at a 4c rate. To sum up, he said that the following would increase business in any town:

Reasonable meter rates, good service, courteous treatment, good wiring at or near cost, free renewals, continuous service, attention to small details, cultivation of acquaintance, careful attention to plant, allowing wiring to be paid for in instalments or on reasonably long time, offering little inducements in the way of labor-saving and comfort-giving appliances as will enlist the interest of the ladies, and at all times impressing upon the people that the company is working for their interests and will do everything possible to render the business relations between the company and the consumer pleasant, agreeable and profitable to both.

SUCCESSFUL WAYS OF INCREASING BUSINESS.

Mr. J. Kermode, of Cleveland, said the success of a central station depends largely on the increase of sales of that class of business which has a tendency to improve the load factor. One of the most profitable sources of increased business of this character lies with present users by increasing their standard of illumination and impressing upon them the possibility of display lighting and the effects that can be secured by the use of electricity for ordinary household purposes. It is generally conceded that by the use of practical heating appliances, electricity in the residence district becomes a source of profit. One of the greatest obstacles in the exploitation of cooking utensils is the improper arrangement of the interior wiring. The ordinary light circuit designed for 660 watts will accommodate any of the smaller devices, but as a general rule such circuits are not satisfactory on account of their location and the length of time required to get desired results.

By establishing friendly relations with contractors and architects their co-operation becomes a valuable means for securing the proper number of outlets, increased capacity of branch circuit, the best attachment suitable for work of this character, and bringing the general standard of construction to a higher level. And it is well worth strenuous efforts to secure and hold such co-operation as an assistant in extending this class of business.

Another serious drawback in the development of this business has been the lack of interest by supply dealers and salesmen who are not thoroughly familiar with proper operation of these devices. Unsatisfactory results have been reported from devices which have been called upon to do work for which they were never intended. The time is ripe for educational work. Much of the business that can be secured will never come unsolicited. A general campaign of education should be started by central station men all over the country. Each manager can inaugurate such a policy by arranging to supply the prospective consumer properly drawn plans and specifications for the use of electricity as an illuminant, as a motive power and for many household purposes.

To illustrate: In many of the larger cities there are a great number of apartment houses which use electricity exclusively as an illuminant. These buildings are only equipped with sufficient gas pipe to connect the cooking range with each meter, and a branch from each meter to a common pipe line which connects to the stove in the laundry. The owners of these apartments furnish the laundry stove and have the branch lines from the meters arranged with valves that are held shut by means of a padlock; each tenant having a key for their own lock. With this arrangement, each tenant pays for his own gas used in the laundry.

Appreciating the amount of business that could be obtained by a similar arrangement, the Cleveland Company induced the owner of a new apartment house to leave out the gas pipe and stove in the laundry, and provide enough electric irons to supply the tenants on their respective laundry days. He then described the electric iron circuit arrangement illustrated on page 25 of the Electrical World for July 7, last.

HOW TO GET AND INCREASE BUSINESS.

Under the head of "Best Methods of Increasing Business," Mr. W. C. Anderson, of Canton, Ohio, called attention first to some of the inherent advantages possessed by electric light in the way of freedom from odor, dirt, fumes or influence by draughts, and to its possibility of control from any distance. Had not the Welsbach gas mantle been invented, the incandescent lamp would be to-day in universal use. Notwithstanding the Welsbach mantle, the incandescent lamp has grown in use enormously. In window lighting, sign lighting, and all decorative lighting, the incandescent lamp is without a competitor. As the product of the central station must be consumed at or near the point of production, and since the market is therefore limited, every possible customer can be card-indexed as to his possible consumption with considerable accuracy. They must not make the mistake of underestimating their selling possibilities. Nearly every private house is a possible customer, as nowhere else are the advantages of electricity so pronounced. Good service is the principal factor in getting and retaining business. Good service consists in furnishing a continuous supply of electricity at uniform voltage to the premises of every customer, together with such supervision of each customer's installation as will result in his greatest satisfaction. In every case, care should be taken to give the consumer the most useful light possible for his money. If a 16-cp lamp with a prismatic glass reflector will give the customer more useful light than a 32-cp lamp without a shade, the customer should be advised to that effect. One well-lighted store is the best canvasser for the neighboring stores, and too great pains cannot be taken to give the store lighted the most handsome effect.

A recording voltmeter should be in continuous service at

every plant and a voltmeter should be applied at the end of each main at intervals to see that the proper voltage is being obtained. Every plant that does not keep a switchboard attendant on that work exclusively should have an automatic voltage regulator, as nothing causes dissatisfaction so readily as to have the lights bright at one period and dim during another. No selling department can be successful without a good product to sell. Like any other manufacturer, the central station manager must have a good factory to be successful. Public lighting done at a small profit will lead to pole lines covering the entire city so that private lighting and power customers can be obtained where otherwise it would not pay to build pole lines to them for their use alone. A uniform rate cannot be successfully applied to this business. We must classify our business and charge according to our investment cost and operating expense. He favored a two-rate system for residence lighting, the demand being computed as a certain percentage of the lamps wired. Maximum-demand meters are too expensive to meet the needs of the case. Flat rates may have to be resorted to for small motor customers and those burning lamps during long hours. This plan must, however, be carried out with extreme care, a flate rate per unit of demand being charged computed on the investment cost and operating cost than for the annual hours used. He believed this less likely to cause trouble than a meter rate low enough to hold the business. Too much care cannot be taken in classifying business to make all rates bear justly against each particular class, the test of any special rate being whether it could be justified before a state lighting commission in case there was one in Ohio. The best help to success is to visit the plant of a successful manager, see what he has accomplished and then try to duplicate or excel his work.

ONE SUCCESSFUL WAY TO GET NEW BUSINESS.

Mr. J. H. Maxon, of Gallipolis, Ohio, took up specially the securing of new business from customers whom solicitors cannot secure by the ordinary methods. The method he advocated was the installation of apparatus on trial and approval. The placing of appliances such as desk fans, laundry irons, small motors, etc., on trial in buildings already wired is comparatively easy and is usually followed by quick sales. The average solicitor can readily handle this class of business, but to secure the business of the skeptical fellow who is very sure that the electric man cannot possibly interest him will usually require the attention of the manager or his assistant. In following out the installation on trial and approval plan it is, of course, absolutely necessary to be thoroughly convinced yourself that service can be furnished to the party solicited to his entire satisfaction if he can be induced to try it. Having determined just what equipment will best meet the requirements, place the electric service proposition before the unconvinced one at a propitious moment, stating that you have so much faith in your ability to give satisfaction with electric service that you are ready to make a proposition to install the necessary wiring and appliances on trial. It is a hard customer that cannot be landed by this method. No doubt many objections can be found to the plan, but if the city operated in is one where there is severe competition, and if the opinion which the public holds of the company is not all that could be desired owing to indifferent service in the past, immediate results can be obtained by this method where all others have failed. If proper care and judgment are used in the propositions made for trial installations very few failures will result.

BUILDING UP A MOTOR LOAD.

Mr. D. W. Low, of the Alliance Gas & Electric Company, outlined the methods he had used in pushing gas stoves, which could also be applied to electric appliances. First, he had a boy distribute cook books which are furnished by the stove company. Each book had enclosed a small folder which acted as an introduction to the solicitor when he arrived. They did not pretend to sell the stove but leased it for so many months, and agreed to give a bill of sale for the stove as soon as the customer had paid the lease for a certain number of months. If a man questioned whether or not he could afford to use a gas stove, the solicitor was able to say that the customer was not obliged to keep it, and that he would remove it without cost to the customer at any time. Of the 500 stoves that were put in, only two have been returned. Without this method of introducing stoves, he did not believe that they could have sold ten stoves per year. He then gave his method of introducing electricity for power. As soon as he ran a twenty-four-hour service, he tried to work up a day load, by talking and bringing data before customers on the power required for different tools. It came down to a question of what it would cost to run by electricity. He could not convince his customers that they could afford to use it, and the result was that for one year about 50 fans was all the power load connected to the day circuit. He purchased three 3-hp motors and two 5-hp motors and went to parties who were using gasoline engines, agreeing to put in a motor and connect it up if they would pay for the current. If they found they could not afford the expense, he would remove it, without expense to them. At the end of three months he sent them a bill for the motor and wiring. Those motors are still running to-day. This gave him a starter, and since then he has, when a responsible man came to him and asked, what it would cost to run a certain piece of machinery by electricity, always replied, "I don't know, but we will put in a motor and find out." The motor never comes out.

CURRENT NEWS AND NOTES.

MAGNETIC SURVEY STEAMER.—A special dispatch from Yokohama, Japan, of August 27 states that the magnetic survey yacht Galilee, which sailed from San Francisco about a year ago in the interests of the Carnegie Institution, was driven on the breakwater at Yokohama during a typhoon on the 24th. She was considerably damaged, but has been refloated and docked for repairs. The crew and scientists aboard are safe.

CONCERNING TUNGSTEN LAMPS.—Mr. W. F. Bay Stewart, president of the Teter-Heany Developing Company, of York, Pa., writes us as follows: "It may be of interest to the public to learn that the pioneer in the art of tungsten lamps is Mr. John Allen Heany, and that this company controls by patents pending in the patent office for several years, these inventions of Mr. Heany. Full disclosures of the above will be given to the public through the electrical papers in due course."

SPANISH SPEECH IS SILVER.—Not to be outdone by the employes in the Postal Department of the Spanish Kingdom, who have presented the young Queen of Spain a solid gold postal card set with precious stones, the employes of the telegraph departments have just forwarded to their sovereign a magnificent telephone transmitter and receiver in solid silver. The piece, which is very elaborate, represents a young man dressed as a hidalgo holding telephone communication with an English girl, thus symbolizing the courtship of the Spanish sovereigns. The transmitter and receiver are held by two cupids.

SUBMARINE BOATS.—The board appointed by the U. S. Navy Department for the purpose of prescribing and supervising tests of subsurface and submarine torpedo boats, under the provision of the Naval Appropriation act, will meet in Washington this week. Capt. Adolph Marix is president of the board and the following officers are members: Naval Constructor D. W. Taylor, Lieut.-Commanders C. W. Dyson, Cleland Davis and Lieut. John W. Timmons, with Ensign Frank H. Sadler, as recorder. The board will prepare a programme of tests and trials, either competitive or comparative, or both, of the kinds of boats mentioned. The programme contemplates a determination of comparative utility and efficiency, with reference to general construction, equipment, machinery, seaworthiness, habitability and adaptability for offence and defence, mining and countermining, and with reference to such other features or purposes or reasonable requirements for submarine warfare as the board may see proper to suggest.

SPANISH CABLES.—The cable connecting Cadiz with Teneriffe has become useless, and the Spanish Government is hesitating as to whether it be more advisable to lay a new one or to rely on the wireless system.

CHICAGO-MILWAUKEE TELEPHONY.—Pupin cables are now being laid underground the whole 90 miles between Chicago and Milwaukee. The trenches are being dug all the way and the work is expected by the Chicago Telephone Company to be done in 1907. There will be 18,000 miles of copper wire in the cables, exclusive of the Pupin coils every two miles.

ARC LAMP ELECTRODE.—A patent issued August 14 to Mr. F. G. Gerard, of London, England, describes a type of electrode for arc lamps which consists of an intimate mixture of carbon with an alloy consisting of magnesium and aluminum. The latter metal, which has a low rate of combustion, is employed for the purpose of preventing too rapid burning of the magnesium. The greater the proportion of magnesium the greater will be the rate of combustion. It is stated that the proper rate of combustion is obtained when aluminum and magnesium are used in equal amounts.

VAGARIES OF ADVERTISING are well illustrated in some recent practice. Out in Pueblo, Col., recently, the gas people advertised for all the dogs in town, each to be accompanied by a boy; and then paraded them with the circus, each dog wearing a bellyband that recommended the use of gas stoves. To say that a sensation was created is putting it mildly. In like manner at the recent opening of the new public bath house, the Peoria, Ill., Gas & Electric Company gave away 500 bathing suits to the children of the town. If our readers know of any other kindred "business-getting methods" we shall be glad to record them—though not necessarily to recommend them.

TROLLEYS IN COLORADO.—According to reports from Denver electric lines will eventually gridiron the whole State of Colorado. The Colorado & Southern is now considering the purchase of a reservoir site in Estes Park to be utilized in creating electric power for the operation of the proposed electric lines in Northern Colorado. The Colorado & Southern contemplates the construction of electric lines as far north as Fort Collins, with branch lines to Estes Park and other points where business is increasing rapidly. All agricultural sections within a radius of twenty miles of Denver will soon be tapped by electric lines built by the Colorado & Southern company. All of these lines will converge in Denver.

THE ICELAND CABLE.—A special cable dispatch from Copenhagen, Denmark, of August 24, says: "Another link in the great telegraphic world system has been completed by the Great Northern Telegraph Company, and its Icelandic cable will be opened to public traffic on August 27. For the present communication over this line will be possible only with Seydisfjord, on the east coast of Iceland, as the land lines which the Iceland Government is building, connecting Seydisfjord with all the main towns and ending at Reykjavik, the capital, are not yet completed. The first section, 215 nautical miles, was laid from the Shetland Islands to the Faroe Islands in ten days. The first message sent was from King Frederick, greeting his subjects on the Faroe Islands. The last section, 327 nautical miles, connects Thorshavn, the capital of the Faroe Islands, with Seydisfjord. The land lines will probably be completed about October 1."

TELEPHONY IN TEXAS.—The Texas Democratic State Convention at its recent session adopted a platform which requires that the next legislature enact a law compelling all telegraph and telephone companies to make wire and business connection with each other at all common points in the State. United States Senator J. W. Bailey, a member of the platform committee, was among those who opposed this on the ground that there was no general demand on the part of the people for such legislation, and that it would work an unnecessary hardship and heavy expense upon the telegraph and telephone companies. Col. Thomas Campbell in accepting the nomination of Governor said he would see that every platform demand was enacted into law. Mr. J. E. Farnsworth, of Dallas, vice-president and general manager of the Southwestern Telegraph & Telephone Company, says such a law would compel telephone companies to make connection at common points and cause a serious impairment of the service of the good companies. A law of this kind would also revolutionize the telegraph business in Texas as the Western Union and Postal would thereby practically become one system.

THE BATTLESHIP DREADNOUGHT, the new largest man-of-war in the British Navy, will have many electrical features in light and power of the usual kind, and some special ones. At the top of her foremast, and immediately over the forward smokestack, is the fire-control platform, upon which will be placed the range-finders. It is probable that on this platform and in the turrets will be installed a new automatic system of range finding and gun elevating, by which the range will be electrically transmitted to each gun position, where by means of synchronized motors, the elevation of the guns will be steadily changed to correspond with the decreasing or increasing range as recorded by the range-finder on the platform. This method removes all possibility of error in the transmission of the ranges or the manual elevation of the guns, and leaves to the gun crew the duty of merely traversing the guns and keeping them fixed upon the enemy. Because of the lofty foretopmast the total height of the fore truck must be fully 200 ft. above the water line. A short mainmast is carried in the usual position, mainly to support the antennæ of the wireless telegraph.

DELAY FOR ELECTRIC TRACTION.—It is alleged that the patrons of the Harlem and Hudson divisions of the New York Central Railroad will have to wait at least two more years before the motive power for the service can be changed from steam to electricity. According to the officials of the road the blame for the delay is with the State Railroad Commission. At present there is an absolute deadlock on the question of eliminating grade crossings, and since this is the first and most essential step in the development of the plan nothing can be done until it is broken by action of the commission. Mr. Wilgus, vice-president of the New York Central, says: "It is a question of humanity as much as anything else," said he, "since our plans, as originally formulated with the commission, called for a four-track system of electric trains, running on an increased schedule and probably at a higher rate of speed that at present for about thirty miles from the city on both the Hudson and Harlem divisions, which would make every grade crossing a veritable death trap. We cannot eliminate these crossings without the sanction of the commission, and unless that is given we cannot complete the work, as it would be the height of folly to run a four-track, fast schedule over surface crossings, as the loss of life would be frightful."

TELEPHONY IN ITALY.—United States Consul Paul Nash, of Venice, reports that the telephone service in Italy, both urban and intercommunal, has hitherto been almost entirely in the hands of two great companies—the Societa Alta Italia, operating in Milan, Genoa and Turin, and the Societa Generale Italiana pei Telefoni ed Applicazioni Elettriche, controlling Bologna, Florence, Rome, Naples and the Sicilian towns. At the beginning of 1904 the ministry of posts and telegraphs took over the Venice telephone system, extending the service, raising the pay of the employes, and reducing the rates, but, in spite of increased expenses, putting aside some $12,000 a year toward a fund for the changing of the entire system. The time has now come when bids for this change are being made, and already three have been received—one from an American, one from a French and one from a German firm. These bids are yet to be submitted to the ministry at Rome by the local director. The ministry of posts and telegraphs appointed recently a commission to investigate the telephone service throughout the country, with the result that in many places a complete change was found to be necessary. In Rome, for example, the service was found to be extremely bad, and that town will probably be one of the first to be modernized in this respect. The appointment of this commission was the first step in the project of the ministry to take over control of the telephone service of the whole country. Milan has the central battery system, which is, as usual, working most satisfactorily.

Westport Station of the Consolidated Gas, Electric Light and Power Company of Baltimore.

BALTIMORE'S supply of electricity has been largely augmented by the opening of the new power station at Westport, Md. This plant which is claimed to be the largest central station in the South and the largest reinforced concrete station in the world, will have a maximum capacity of 30,000 horse-power, which is more than equal to the highest demand yet made upon the company. The power house is advantageously located on the outskirts of Baltimore on the Patapsco River and includes 23 acres of land lying between the tidewater line of the Western Maryland Railroad and the Curtis Bay branch of the Baltimore & Ohio Railroad. Its close proximity to these railroads and with water connection to the Canton branch of the Pennsylvania Railroad gives it the advantage of transportation facilities from the three great coal-carrying roads entering Baltimore.

In view of the company's experience during the recent conflagration in Baltimore, the reasons for locating the new station at Westport are interesting. In selecting the site the determining points were as follows: 1. Isolation from adjacent buildings, eliminating exterior fire hazard. 2. Transportation facilities, which include all three coal-carrying railroad systems entering Baltimore with additional water delivery from the Baltimore & Ohio railroad's station at Locust Point. 3. Storage capacity sufficient for a coal supply for a whole year. Coal strikes, railroad strikes, blockades and congestions or any other cause that might temporarily halt the supply of coal from the mines can therefore have no effect upon the plant. 4. Room for extension as found in the large area which the company has acquired, giving ample space for expansion of the plant to supply the needs of Baltimore, however great they may become in the future. 5. Water supply for the boilers and for condensing purposes in abundance.

Ground was broken for the new station on August 16, 1905, and the first engine was turning on June 15 of this year, or ten months after. As stated above, the station is built entirely of reinforced concrete. Not a stick of wood is used in the construction—foundations, walls, floors, pillars, galleries, coal bunkers, and discharge chutes for ashes from the furnaces are all built of concrete. The framing for windows and doors is of steel. In the center of the building is the largest smoke stack about Baltimore. This has an inside diameter at the top of 14 ft. and is 209 ft. high. Radial brick is used in its construction. In addition to natural draft furnished by this chimney the boiler room is equipped with forced draft to provide for any sudden demand for power. The building is 255 ft. deep and 115 ft. wide. It is a single story 70 ft. high, with operating galleries and coal storage, and is constructed so that additions can readily be made to enlarge its capacity. The boiler room will contain eighteen 650-hp Babcock & Wilcox boilers plans for an additional boiler room being already completed. The boilers are equipped with superheaters and are hand fired with bituminous coal.

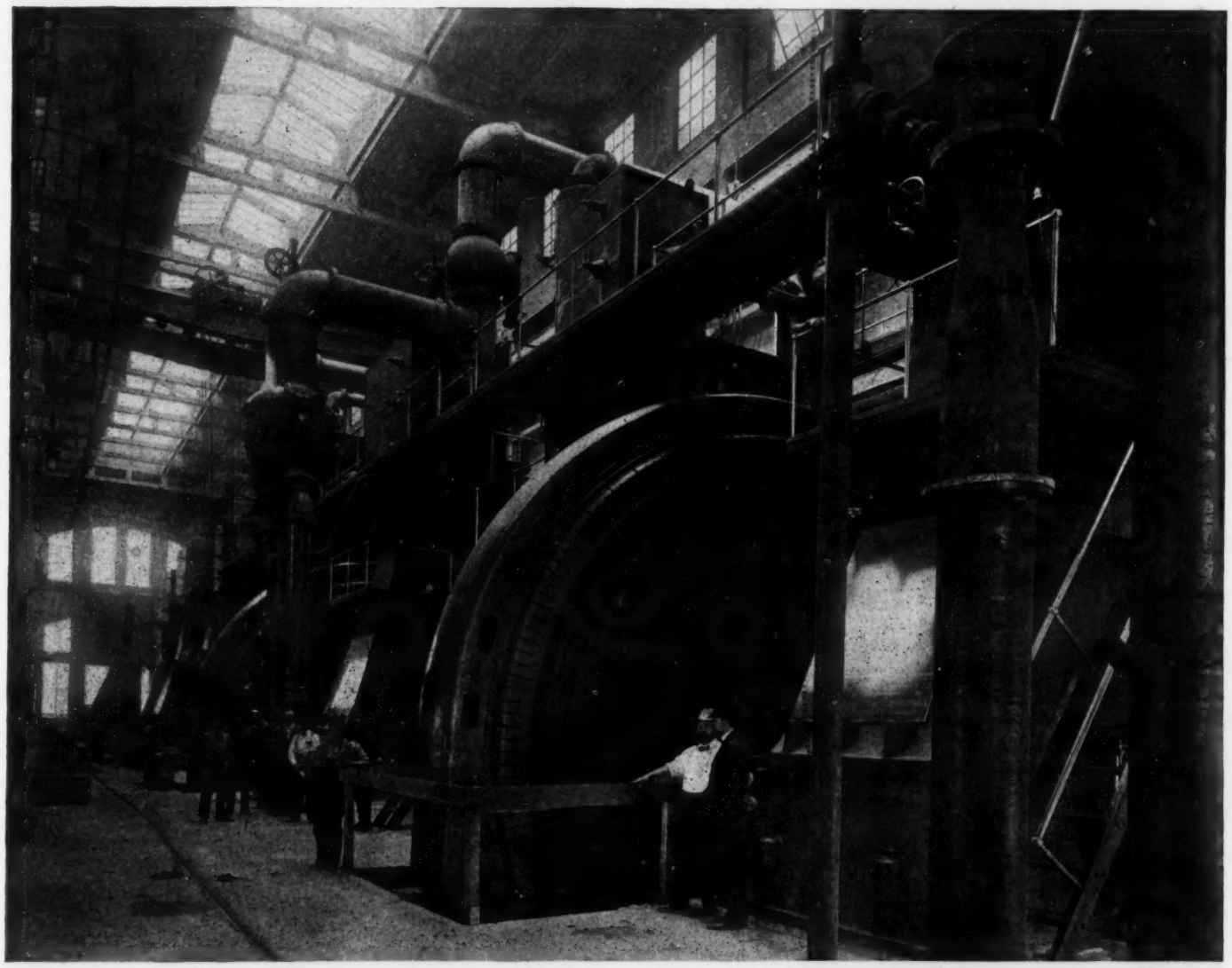


FIG. 1.—WESTPORT STATION OF THE CONSOLIDATED GAS, ELECTRIC LIGHT & POWER COMPANY, OF BALTIMORE, MD.

The coal is stored in bunkers above the boilers and is fed by gravity to the boiler room floor. These bunkers are filled by coal handling machinery of the latest type so that the coal in transit from the barge or cars is automatically handled. The boilers discharge their ashes through reinforced concrete chutes into cars which run on an industrial track in the basement. These ashes are run out under the gantry crane and are used to reclaim low land now under water.

Extending from the wharf to the power house is a large gantry crane which is about 293 ft. long and is arranged to carry the bucket trolley described below. The structural part of this gantry was provided by the Lauer & Harper Company, of Baltimore, although all the driving mechanism and other machinery in connection with it was furnished by the Morgan Engineering Company of Alliance, Ohio. This crane is driven by a 50-hp motor controlled by an electric controller designed by the Morgan company. Under normal conditions the bucket trolley passes out of the building on to the gantry structure and thence without moving the gantry direct to the wharf where the bucket is loaded, hoisted and again returned to the building. Should it be desired, however, to take coal from the coal piled in storage in the yard the bucket trolley passes out of the build-

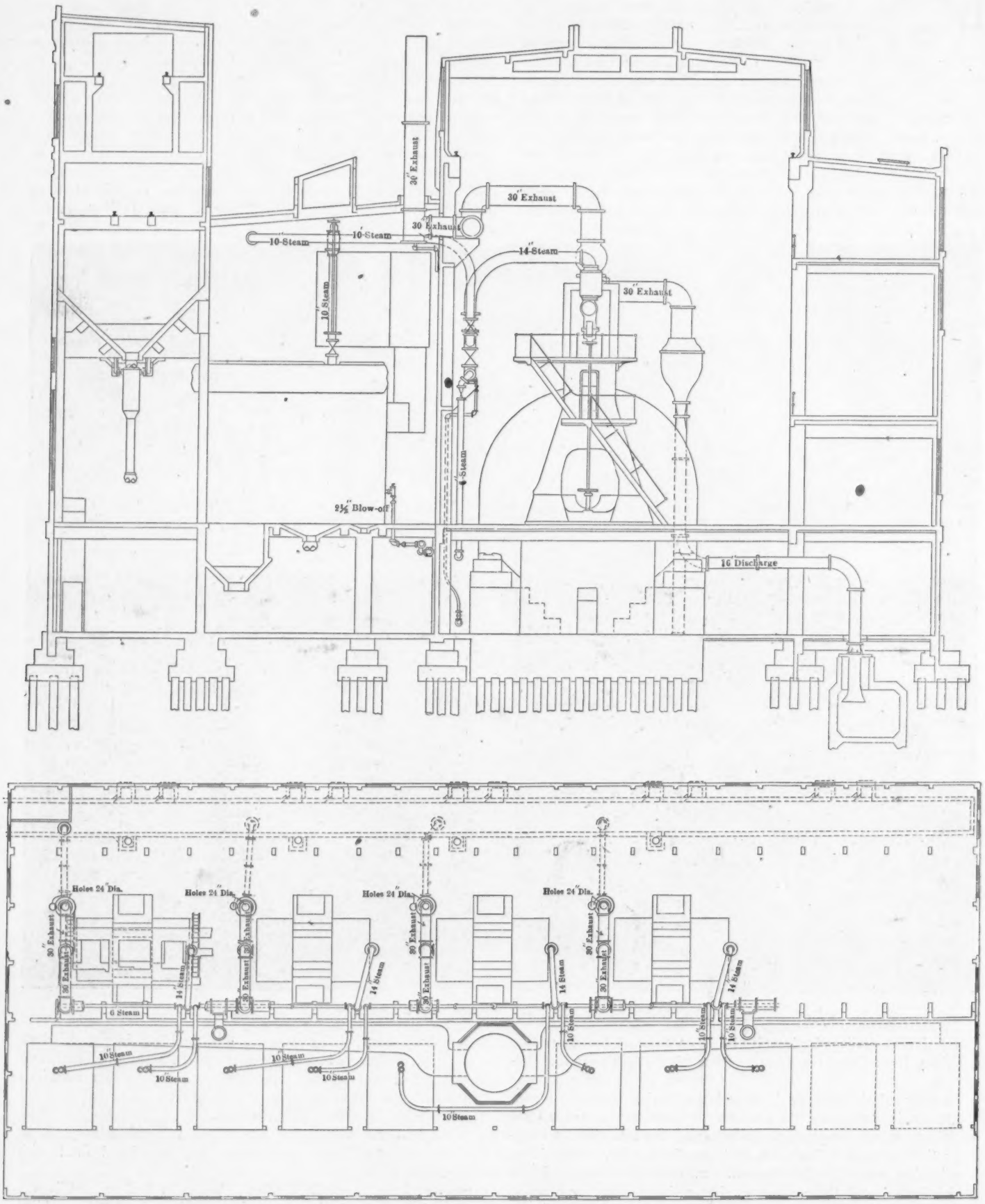


Fig. 2.—Cross-Sectional Elevation and Plan View of Westport Power House, Showing Steam and Exhaust Piping.

ing on to the gantry which is then moved over the coal pile where the bucket is loaded. The crane is then moved back opposite the opening into the building and the bucket trolley passes into the building as usual, depositing its load in the hopper of the crusher trolley.

The bucket trolley carries and operates a large clam-shell bucket, especially designed for handling coal. This trolley is supplied with three independent electric motors which in turn are operated by controllers placed in a cage attached to the trolley. The main hoist motor is 50-hp, the bucket-operating motor 25-hp and the trolley-travel motor 25-hp. The opening and closing of the bucket is accomplished by a very ingenious arrangement of differential gearing which gives the operator perfect control of the bucket at all times and enables him to open and close it entirely independent of the hoisting and lowering mechanism of the bucket.

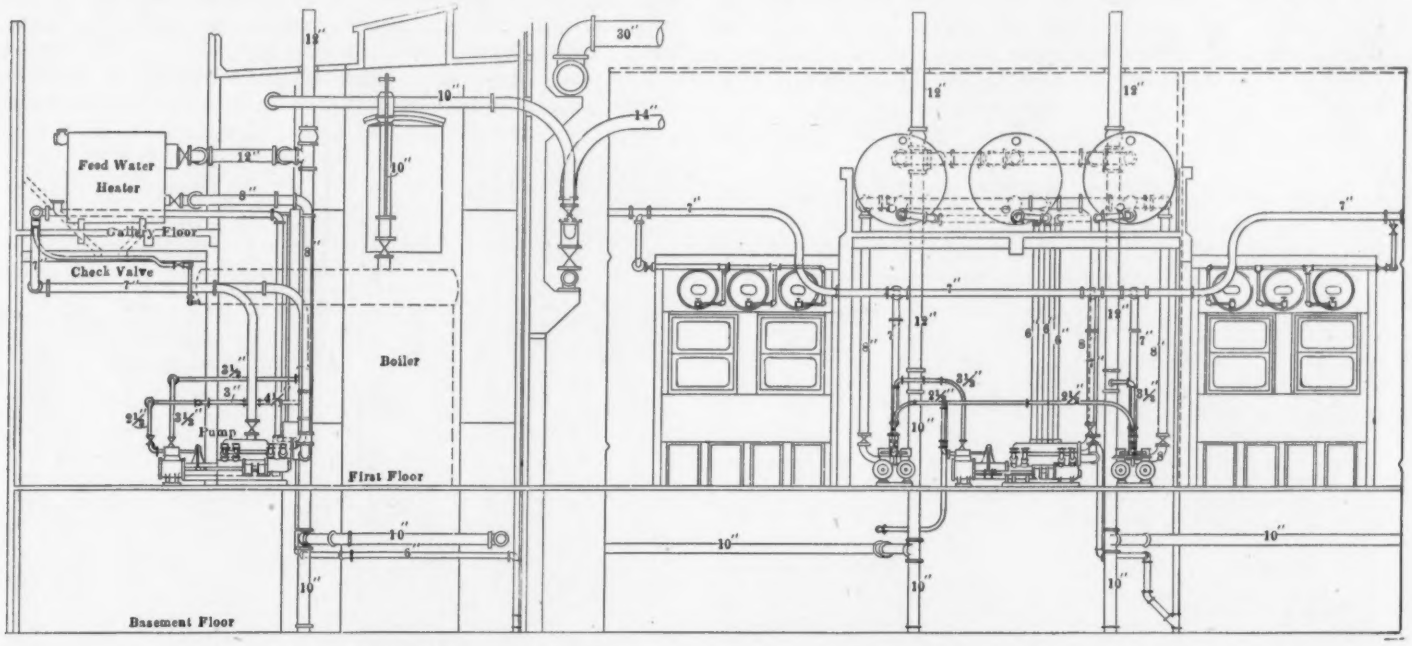


FIG. 3.—DIAGRAM OF FEED WATER PIPING IN WESTPORT STATION.

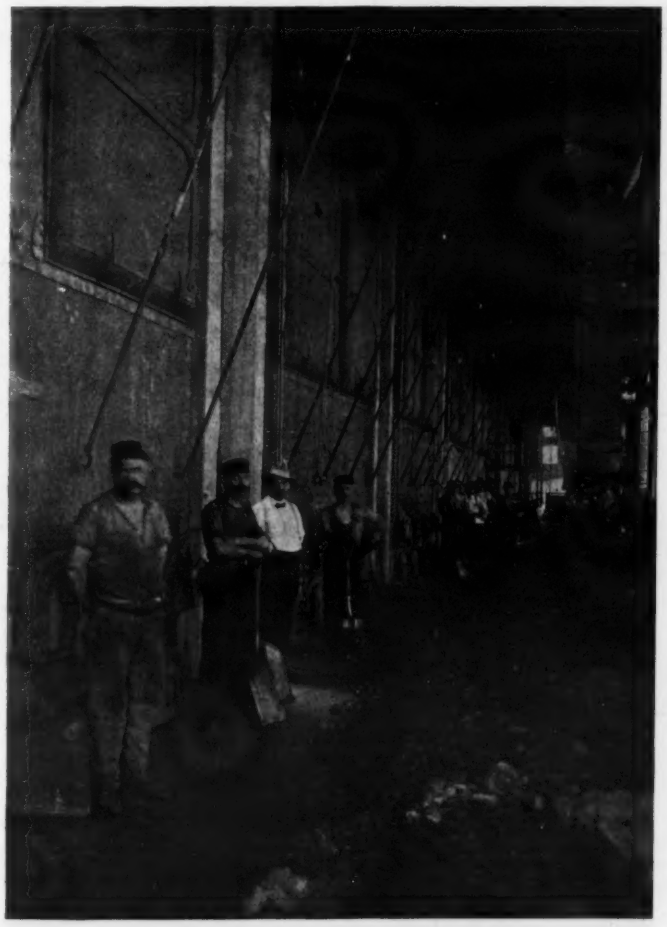


FIG. 4.—GENERAL VIEW OF BOILER ROOM.

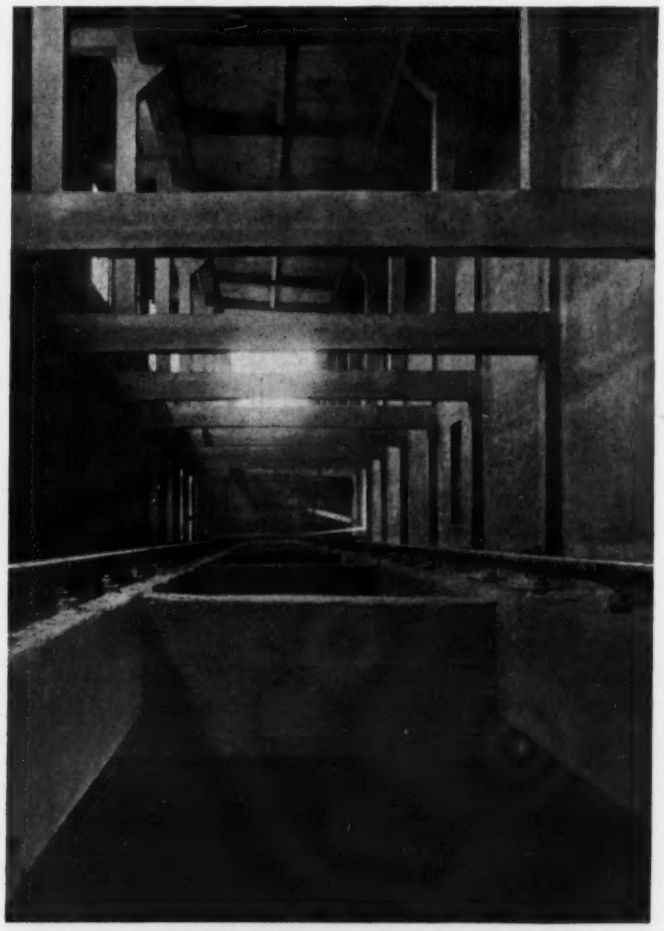


FIG. 5.—REINFORCED CONCRETE COAL POCKETS.

For this class of work, in order to economize time as much as possible, it is desirable that the bucket should lower very rapidly from its highest to its lowest position. To accomplish this, the main hoist motor has a compound winding and the

lowering of the bucket is controlled to a nicety by a 60-point rheostat with armature short-circuiting resistance by means of which the bucket can be dropped very rapidly and stopped at any point quickly and easily by the operator in the cage. As stated before, the operator's cage is attached to this trolley so that the various motions are under direct control at all times, whether working outside the building on the gantry crane or inside the building over the coal pockets.

In the building over the coal pockets the Morgan Engineering Company has provided an electrically-operated crusher trolley or carriage. This trolley is equipped with a hopper which is of structural steel and which is made in such a manner as to be easily filled by the bucket trolley operating over it. At the lower end of the hopper is a crushing arrangement driven by a 10-hp motor. This trolley is at all times under the control of the operator located on a stationary platform in the building. The cross travel of the trolley is operated by a 5-hp motor on the operator's platform. The crusher trolley can be moved over any one of the several pockets in the building and the coal crushed and emptied into the desired pocket.

On machinry of this kind it is very necessary, of course, to cover all the gears, motors, and other apparatus to prevent the dust and coal from getting into them. This point, as well as all other such items has been carefully considered and taken care of by the builders of the coal handling machinery, and in all parts provision has been made for the constant lubrication of journals and bearings and care taken to reduce friction to a minimum. The motors are all of the direct-current type operating at a potential of 220 volts. The approximate hoisting speed is 100 ft. per minute and the approximate cross travel speed is 650 ft. per minute. From the crusher the coal passes to the coal pocket thence through a cut-off valve to a one-ton traveling hopper which delivers coal to the boiler room floor. There are at present four hoppers in use. Poke holes are provided to loosen up the coal should it have a tendency to clog. The coal handling machinery is capable of delivering coal from the barge to the field at the rate of 150 tons per hour and from the barge to the bunkers at the rate of 60 tons per hour.

Feed water for the boilers is taken from the Gwynn's Falls, under the Baltimore & Ohio Railroad bridge passing over the falls, and after being filtered is stored in a lake constructed for this purpose holding 1,750,000 gallons. This lake is situated between the station and the filtering plant shown in Fig. 6. The water is pumped by two motor-driven, 5-in. vertical submerged centrifugal pumps, through 8-in. bell and spigot pipe to the coagulating basin about 1,200 ft. distant. Before the water enters the coagulating basin, a coagulant of alum and lime is mixed with the water. In the pipe line between the pump and the coagulating basin is a controlling valve which works automatically and keeps the water at a uniform height in the coagulating basin.

The coagulating basin which is shown in Fig. 6 is built of reinforced concrete and is 40 ft. wide by 50 ft. long, and has a capacity of 200,000 gallons of water; allowing three hours and ten minutes sedimentation in the tank before it reaches the filters. The water passes out of the coagulating basin into a 16-in. pipe in which is a regulating valve to keep the water at a uniform height in the filters. The coagulating basin is provided with two blow-off valves so that the sediment which collects in the basin may be blown off at intervals.

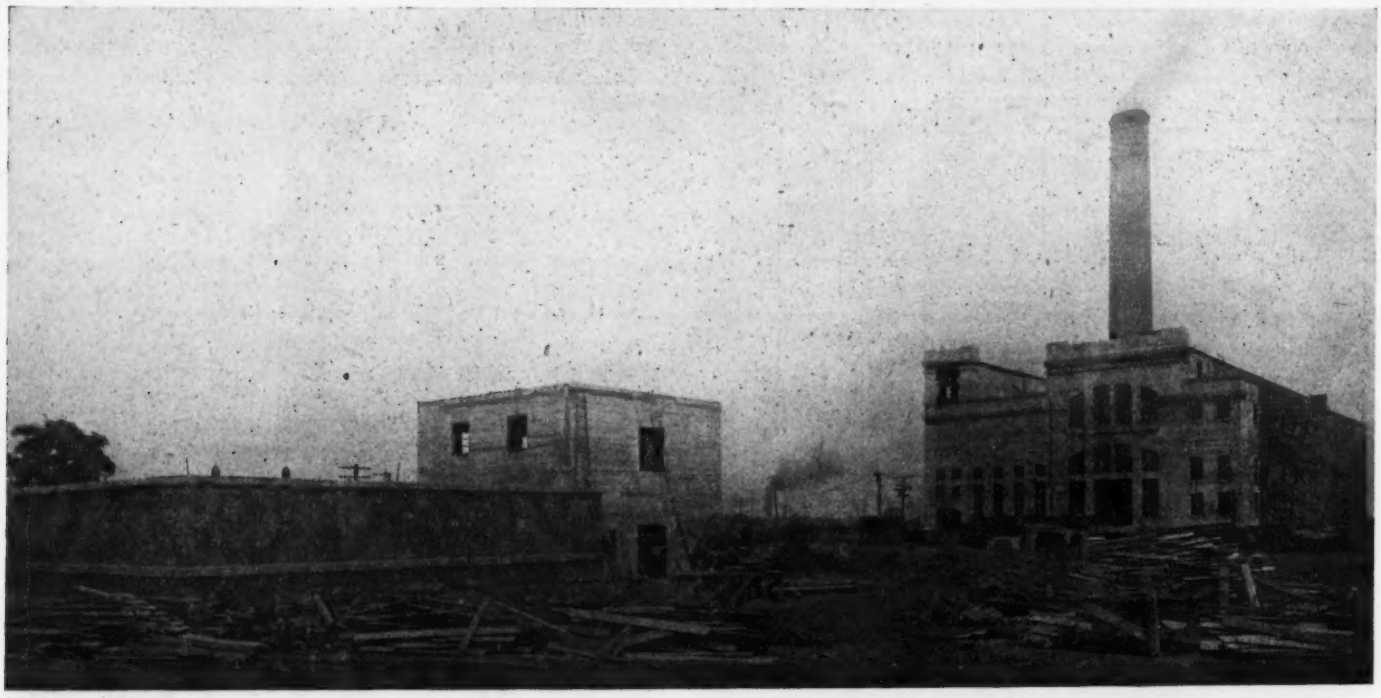


Fig. 6.—Exterior View of the Westport Station, Showing Water-Purifying Plant in the Foreground.

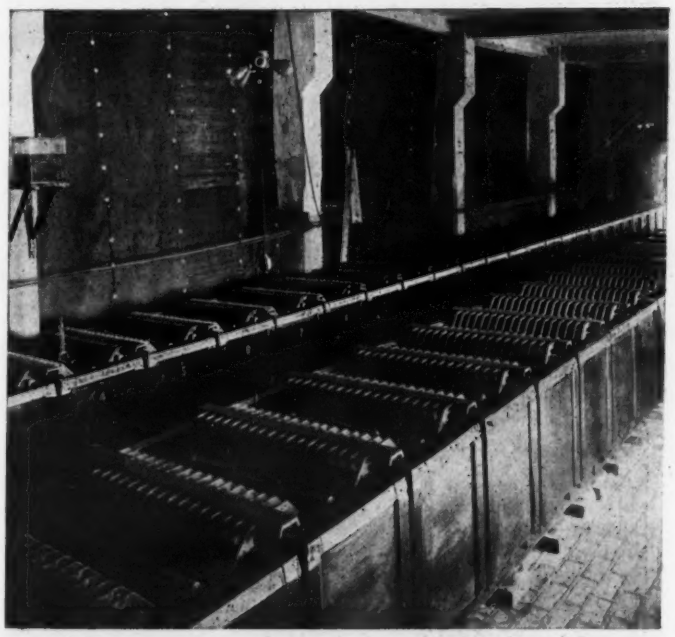


FIG. 7.—CORNER OF STORAGE BATTERY ROOM.

There are three concrete filter beds of 160 sq. ft. each. These have a capacity of one-half million gallons in twenty-four hours and in the bottom of the filter bed is a cast iron manifold pipe into which galvanized laterals are screwed on about 11-in. cen-

ters. Into these pipes are screwed strainers for holding back the sand and gravel and for collecting the filtered water. On top of the strainers is placed 9 in. of gravel and on top of this gravel is placed 30 ins. of specially prepared sand of a uniformity of about 0.40 mm. with a coefficient of about 1.5.

Running lengthwise of the bed where the coagulated water enters to filter bed, is a specially constructed wrought-iron box

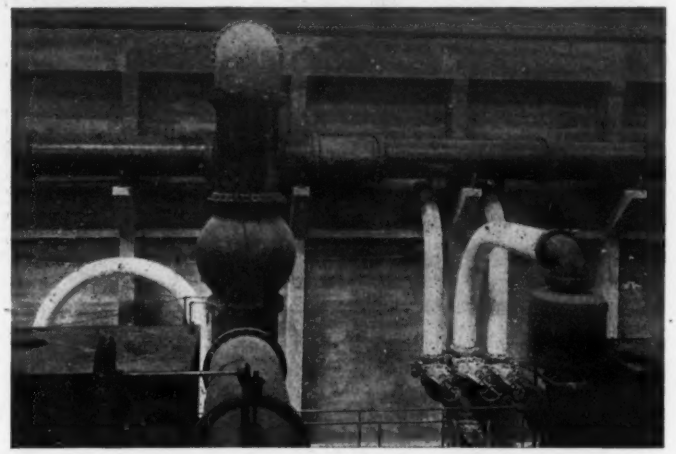


FIG. 8.—STEAM AND EXHAUST PIPING ON MAIN UNITS.

through which the water flows into the bed. After the water passes through the sand it is collected in this main collector pipe which runs to the outside of the filter bed, and on the outside of the filter bed is a valve discharging into a rate controller located in a canal running in front of the beds. This rate controller is of such construction that the flow of water from the bed is fairly uniform, the variation not exceeding 5 per cent. The rate controller can be changed to increase or diminish the flow. Connection is made from the discharge pipe of the filter beds next the rate controller to a loss-of-head tube. This is about 6-ins. in diameter and is fitted with a float. On top of the tube is a gauge which registers at all times the loss of head or friction in the sand caused by the water passing through it. There is also an electric alarm connected to this tube which causes a bell to ring when the filters need washing.

The discharge pipe from the filters is also connected to an 8-in. pipe which is connected to a tank in a tower located outside the filter house for washing the filters. On top of the gravel layers and underneath the sand layers is an air pipe system consisting of brass air pipes placed every 4 ins. apart. Air is forced into these pipes so as to thoroughly wash the bed in connection with water. When a bed needs washing, the coagulated water is shut off through the pipe leading to the bed, and the discharge from the filter is also shut off. The valve connecting to the wash line is then opened and at the same time air is turned on in connection with the water. The dirt collected on top of the filters is then washed over into the wash overflow box which is connected with the sewer. The air is used in connection with the water for about three minutes after which it is shut off and the water used alone for about one minute and a half longer. From the canal a pipe leads to the clear water storage basin previously mentioned. There are connections made from this clear water basin to pumps for forcing the water around the plant. Coagulated water may be run direct to this clear water basin should anything happen to the filters, and raw water can also be run either direct or through the filters without going through the coagulating basin should this be desired.

The filter house and filters are built of reinforced concrete, and over the filters is an office and also a coagulating room where the coagulant is mixed. This coagulant is mixed in round cedar tanks, two tanks being used for the alum and two for the lime. The discharge from these tanks empties into a regulating box which has an adjustable orifice. From the regulating box the coagulant is discharged into the raw water pipe and thence to the coagulating basin. Pipes are also arranged so that the coagulant can be put into the water after it has passed part way through the coagulating basin, if it is found at times that the water does not require so long a period of coagulation. The filters are designed to remove practically all the turbidity and color from the water and at least 97 per cent of the bacteria. There are no traces of the coagulant in the filtered water. The object of using the lime is to neutralize the alum coagulant if the alkalinity in the water is running low. The plant is at present using city water for which it must pay; but when the filtering plant and clear water basin are complete the water will be pumped from Gwynn's Falls and the only expense for water will be the cost of pumping and filtering it. From the lake the water is pumped into the heaters and a 70,000 gallon tank placed 65 ft. above mean low tide. The filtering system was installed by the Norwood Engineering Company of Florence, Mass.

From the boilers the steam is delivered through high grade steam piping to the engine room. Diagrams and photographs showing the sizes and arrangement of the piping are given herewith so that an extended description is unnecessary. The high-pressure steam piping system has been greatly simplified by the grouping of adjacent boilers and generating units into independent power groups, each two boilers and engine located opposite constituting a complete power plant, which is connected to the remaining equipment only by a small interconnecting tie-line for emergency purposes. The two 10-in. lines from each pair of boilers are joined on the engine side of the division wall into a 10 by 14-in. cross-fitting to which a 14-in. line is connected to supply the engine, while a second 14-in. connection provides for the interconnecting tie-line. These connections are all fitted with stop valves so that either one or both boilers may deliver to its adjacent engine, entirely independent of the remainder of

FIG. 9.—GENERAL VIEW OF ENGINE ROOM.

the plant, or they may deliver through the interconnecting tie-line to any of the other engines. The tie-line is merely a 10-in. header, carried on wall brackets on the division wall, which connects into each of the cross-fittings of the independent systems; it is not intended that this line will be ordinarily in use, but rather held in reserve for emergency conditions. The boiler connections are fitted with non-return stop valves at the boilers and

the engine supply line with a Webster separator at the throttle connection. These steam lines are all drained by a high-pressure drip system, from which the condensation is removed by vacuum pumps and automatically returned to the feed water heaters.

Owing to the elevated arrangement of the engine condensers, which are of the barometric jet type, the exhaust piping is very simple, involving short direct connections to the condenser jet chambers and also through back-pressure valves to the atmospheric exhaust systems. The exhaust connections are all of 30-in. pipe, that to the condenser involving a short connection, about 10 ft. in length, from the low-pressure cylinder to the condenser alongside. Immediately above is the back-pressure valve from which connections is made to the 30-in. exhaust headers carried on wall brackets on the division wall. These headers, of which there is one for either half of the engine room, are of spiral riveted pipe and have connected at their middle points atmospheric relief risers leading above the roof to exhaust heads. These headers are similarly drained by a low-pressure drip system. The feed water is pumped by three Worthington duplex pumps through three "star-vacuum" feed-water heaters built by Warren Webster & Company, of Camden, N. J. Four Warren Webster separators are also in use.

Views of the engine room are given in Figs. 1 and 9. The equipment in this room will consist of four vertical compound condensing engines having a rated capacity of 3,000 hp, with 50 per cent overload giving a maximum capacity of 18,000 hp. The fifth engine to be installed will be a combined horizontal and vertical compound condensing engine coupled to a 5,000-kw fly-wheel alternator. The engine will have cylinder dimensions of 38 and 78 in. by 56 in., and will develop 7,500 hp with a maximum capacity of 11,250 hp, making the aggregate capacity of the plant 30,000 hp. These engines are built by McIntosh, Seymour & Company, of Auburn, N. Y., and do not differ from their regular type with the exception of the larger engine which

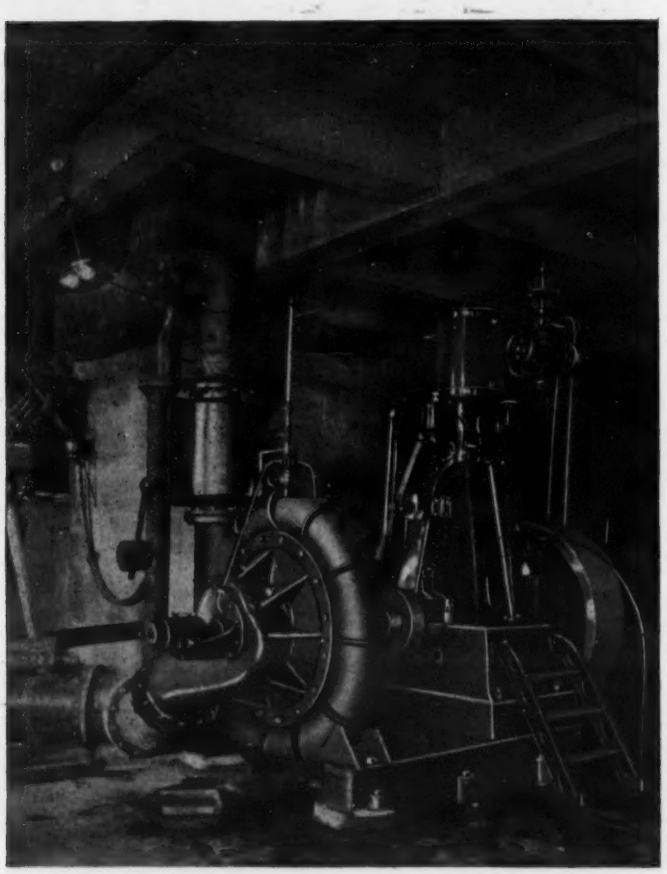


FIG. 10.—STEAM-DRIVEN CENTRIFUGAL PUMP FOR CONDENSER INJECTION WATER.

is built by license under the patent granted the Allis-Chalmers Company. This engine will be similar to the engines in the power house of the Interborough Rapid Transit Company, in New York City.

The condensing apparatus installed follows this general arrangement: Each engine is furnished with an individual Worthington barometric jet condenser of special design to meet the particular requirements of service. These units are of the well-known elevated type consisting of a cone, in the interior of which is located an air cooler. This cooler performs the very important function of assisting in the removal of all non-condensible vapors from the cone. The vapors circulate through a series of pass-

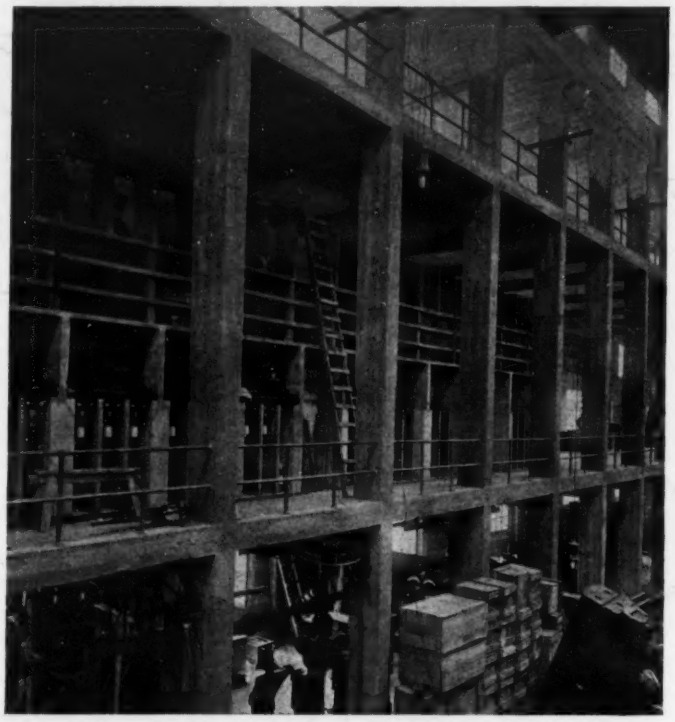


FIG. 11.—VIEW OF THE GALLERIES, SHOWING REINFORCED CONCRETE SWITCH AND BUS-BAR CELLS.

ages around which injection water is constantly circulated at its lowest temperature, insuring that these vapors will be reduced to the smallest volume and eliminated from all suspended water. At the bottom of each cone is a special throat piece covered by patents of Mr. P. O. Keilholtz, which automatically takes the air vapors from the air cooler and introduces them into the falling column of water in the barometric leg. The injection water to each condenser is supplied by a 12-in. Worthington special pattern, volute centrifugal pump driven by a Reeves high speed engine. Rotative dry vacuum pumps are used in connection with these units only at the time of starting the condensers. Their action is to assist in removing from the system all non-condensible vapors in order that the centrifugal pump may work under normal operating conditions.

The water for condensing purposes is taken from the Patapsco River through a double reinforced concrete tunnel, having the intake below and the discharge above. Each of these passages is 6 feet high by 8 feet wide. Ears are provided on the side into which the suction pipes project. The top of the tunnel is even with the water at mean low tide, while the bottom is 15 feet below mean low water. A weir is placed in the discharge tunnel so that the upper tunnel is always full of water. By this means the ends of the discharge pipes are never uncovered so that the vacuum is never lost. Screens are provided in the intake tunnel to keep out all foreign matter. These are made of No. 8 brass wire with 2-inch mesh enclosed in an angle iron frame sliding in grooves provided in the concrete. Two of these screens are placed in series so that one may be cleaned whenever this is desirable without rendering it possible for foreign matter to find its way to the suction. The waters of the Patapsco are somewhat saline.

The electric generating equipment consists of four 2,000-kw, 25-cycle, 13,000-volt, three-phase General Electric alternators, direct-connected to the prime movers, and one 5,000-kw machine. There are no transformers in the station and current at a potential of 13,000 volts is sent through oil switches to the other stations operated by the company. The switch cell and bus-bar structure is built of reinforced concrete on the second gallery as shown in Fig. 11. The switches used are of the Westinghouse

type C make, and twenty of these are installed. Directly above the switches and separated from each other by concrete partitions are the bus-bars. These are in duplicate and in sections. Knife switches are provided between the cables and oil switches, between the oil switches and bus-bars and also between the generator leads and oil switches, so that any oil switch may be worked on by simply pulling the knife switch. Motor-generators are used to supply the exciting current and also to charge 54 cells of battery which float on the exciter system. The battery is situated in one corner of the top gallery, the rest of which will be utilized for men's lockers. The second gallery will be devoted entirely to high-tension apparatus, such as switch cells, and bus-bar structures. It is worthy of note that all of

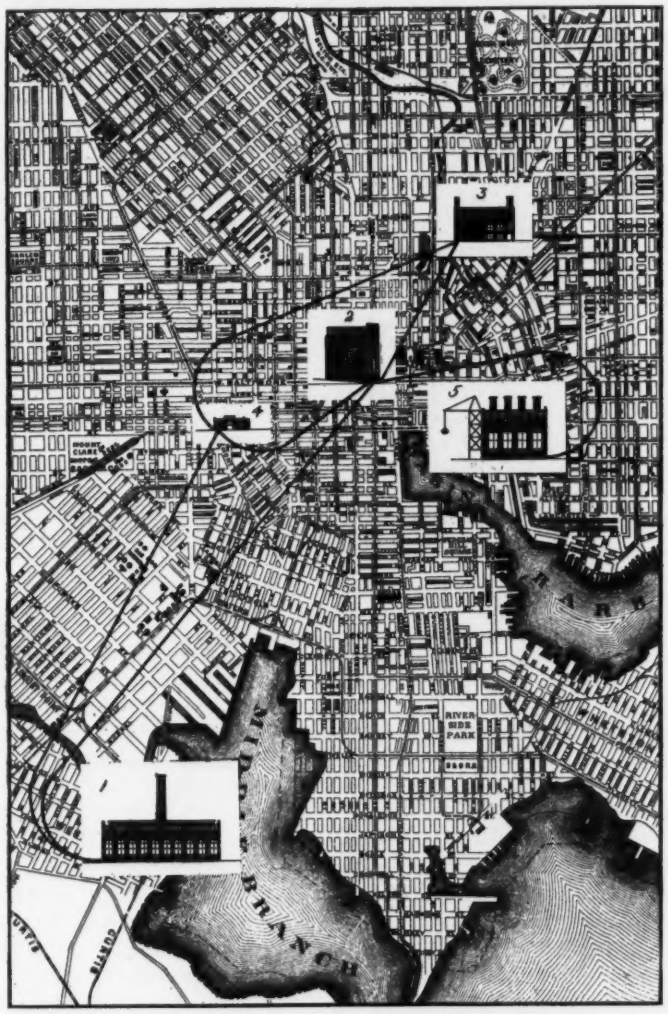


FIG. 12.—MAP OF BALTIMORE, SHOWING LOCATION OF STATIONS.

the auxiliaries in the station are steam-driven and operate against a back pressure of 25 pounds. The exhaust is delivered into the receivers of the large engines so that the auxiliaries operate almost as condensing engines.

From the Westport station the electricity is transmitted in lead-covered cables placed in subways built by the company from the power house to a junction with the municipal subway, which carries cables to the Pratt and Penn street station, the McClellan street station and the Monument and Constitution street station. The location of these stations is shown in the accompanying map. In this engraving the numbers have the following significance: No. 1 is the main generating station at Westport; No. 2 is the McClellan street sub-station; No. 3 is the Monument street generating and sub-station; No. 4 is the Penn street generating and sub-station, and No. 5 is the Pratt street power house of the United Railways, which runs the entire street railway system of Baltimore. The Pratt and Penn street and the Monument and Constitution street stations are now steam driven; but after the energy from Westport is received, the steam engines will be shut down, disposing of whatever objection there may be to the smoke from these stations. The McClellan street station and the other two stations are equipped to receive the energy from Westport. This equipment includes the machinery for transforming and reducing the voltage and current.

Important as is the immunity from fire hazards and guaranty of a non-interrupted coal supply to the customers of the company, there is still another advantage obtained in the plant at Westport. This advantage lies in the fact that 25-cycle electric apparatus has been installed which has the same characteristics as the equipment which furnishes electricity from the Pratt street power house of the United Railways. Since both of these stations are tied together it is possible to interchange electricity between these two large power houses in case of accident. Referring to the map of the system, there are two cables tying stations one and two; two cables tying stations one and four; one cable tying stations two and three; one cable tying stations two and four; three cables tying stations two and five, and one cable tying stations three and four.

The company supplies direct-current on a 120-240-volt system through underground mains in the central portion of the city, known as the subway district for the reason that municipal conduits are used for the purpose. Outside of this section single-phase and three-phase service at 25, 60 and 140-cycles is available for general service, together with three-wire direct-current service for motor circuits at 220 volts on each side. Commercial and municipal direct-current series arc circuits are also maintained. The subway district is fed from the McClellan Street station. This station, it may be remembered, was ready for operation at the time of the great fire of 1904, and although in the hottest zone of that fire it successfully withstood the onslaught of that calamity with no interior damage. Invitations were to have been mailed the day after the fire for the opening of this new rotary station which was to be supplied with electricity from the United Company.

The business of the company is attended to by a well-organized department and some of the methods are of interest. When the management decided last summer on the Westport station, with a maximum capacity of 18,000 horse-power, it was thought that provision had been made for the likely increase in business; but last year the business of the company showed the phenomenal increase of 42 per cent, so that it became necessary to greatly enlarge the plans for the new station. To care for the needs of customers an attractive show room is maintained on the ground floor of the Continental Building, probably the most convenient location in the city, and besides a sufficient office force there is a corps of solicitors each having charge of the business in a particular district. One solicitor devotes all his time to motor work. There is a service inspector and also a special canvasser whose work is general throughout the city. The company employs newspaper advertising, each paper being used twice a week with first-page display, the advertisements being changed each issue of any paper. The company also issues a bulletin entitled "Notes on Electric Service," which has run through about two hundred pages in the two years in which it has been published. The aim is to treat some one subject in a clear, concise, and well-illustrated manner in each issue. The company counts most on personal solicitation for the development of its business so that the publicity campaign is made secondary to actual canvassing. To educate the public in all the possible uses of electricity would mean that the Baltimore Electric Power Company, which also operates an electric plant in Baltimore (See ELECTRICAL WORLD, July 14, 1905), would derive a benefit from such advertising at the expense of the Consolidated Company, so that with the opening of the Gould street station of the former company more attention was given to solicitation and less to general advertising.

The power station and its equipment were built and installed after the plans of Mr. P. O. Keilholtz, consulting engineer. The Consolidated Gas, Electric Light and Power Company is the successor of the United Electric Light and Power Company and owns a large majority of the stock of the Consolidated Gas Company. Mr. Alten S. Miller is vice-president of the company, Mr. P. O. Keilholtz is the consulting engineer, Dr. Douglass Burnett is the manager of the electrical department and Mr. W. Stuart Symington is secretary and treasurer. Mr. S. Davies Warfield is chairman of the board of directors of the company and of the executive committee of the board.

Wiring and Lighting Equipment of an Eight-Room $3,500 Residence.

At the convention of the Ohio Electric Light Association Convention at Put-In-Bay, Ohio, August 21, 22, and 23, Mr. J. R. Cravath read a paper on the proper wiring and lighting equipment of an eight-room residence of a cost of about $3,500. This problem, he said, had probably to be dealt with more frequently by most of the members of the association than any other class of customers' installations. He outlined a number of good lighting plans for each room, thus giving opportunity for a choice among several efficient schemes, as one would naturally do in dealing with prospective residence customers.

He assumed that the eight-room, $3,500-residence had, in addition to the basement, the following rooms: Living room, library, reception room or den, dining room, kitchen, pantry, four bed rooms, one bath room. As far as these rooms are concerned, the problem is fairly definite and uniform in nearly all such houses. The principal variations will be in the hall and stairway arrangements and porch. Taking up the rooms he gave for each room the choice of several different schemes, which are designated A, B, C, etc. Fixture drawings are given simply to indicate the number and position of sockets. The fixtures may be as plain or as elaborate as desired.

LIVING ROOM.

Plan A—Place one 3-light chandelier of the general style indicated in Fig. 1 in the center of the room. Equip the center socket with a prismatic reflector which will throw a strong light down under the chandelier for reading purposes. Equip the chandelier arms with Holophane Class B stalactite globes for the general lighting of the room. These diffuse the light and direct it downward. The prismatic reflector on the center socket should be chosen with reference to the amount of area to be illuminated. If not more than two persons are likely to wish to read under the chandelier, a very deep concentrating reflector can be used. If several persons are likely to be reading in the room in the evening, one giving a wider distribution is necessary. The general lights on the chandelier arms should be sufficient to light the room well in all parts on special occasions. If the room is large, use a 3-arm chandelier, but this is seldom necessary in a house of this size.

Plan B—Use a fixture like that shown in Fig. 1 and equip the center socket with a 7-inch opal dome reflector and frosted lamp. Equip the chandelier arms with frosted lamps in small opal ball reflectors. This will give similar results to Plan A with a slightly lower cost of glassware. Some will prefer the opal to the prismatic glass. Opal reflectors cannot be obtained, however, which concentrate as much light over a small area as do prismatic reflectors.

Plan C—Use such a chandelier as in Fig. 1 and equip the chandelier arms with Holophane Class B stalactites and the center reading socket with a Holophane Class A stalactite. This will not give as good a reading light as Plans A and B, but it is more artistic in appearance and places all lights behind diffusing globes.

Plan D—Use chandelier indicated in Fig 1 and equip the arms with sand blasted or frosted balls. On the center socket for reading purposes use a prismatic reflecting ball with lower half frosted. This is less efficient than any of the previous arrangements proposed, but very handsome.

Plan E—Place a hemisphere in the center of the ceiling, using inside the hemisphere one lamp pointed straight down and equipped with a flat reflector. Either a ground glass or Holophane hemisphere can be used with good efficiency. An opal or opaline hemisphere should not be considered. Place a bracket like Fig. 5, with lamp at an angle of 25 degrees, at the point in the room which the owner wishes to use for reading. Equip the bracket with a frosted bulb lamp and a prismatic reflector.

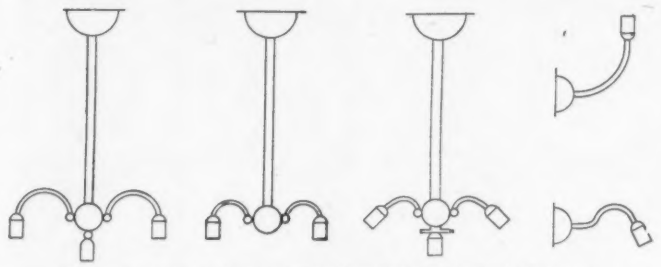
It is also a good plan to place in the corner of the room which is likely to be used for a piano a flush wall receptacle. This wall receptacle can be used for a piano lamp, fan or ornamental table lamp. The electric table lamp is not to be recommended for useful reading purposes, however. Better results can be secured by putting the reading lamp in a good reflector on the chandelier or wall bracket, as indicated in the previous plans outlined. Of course with the reading light on the chandelier the table should not be placed under the chandelier as that is the very place which should be occupied by the persons reading in order to get the best light.

LIBRARY.

In the ordinary eight-room house there is usually a small room which is used variously, according to the ideas of the owner, for a library, reception room or den.

Plan A—Place in the center of the room a 2-light chandelier of the general design indicated in Fig. 2. Equip with two prismatic reflectors. These will light the library table, which will naturally be placed under the chandelier, and will also give enough light on the book shelves to read book titles. A portable table lamp is good on a library table when the reading is done on the table close to the lamp.

Plan B—Use chandelier, Fig. 2, and equip with 7-inch opal dome reflectors. This will give about the same results as Plan A Use frosted lamps in either case. One wall receptacle is also



FIGS. 1, 2, 3, 4 AND 5.—CHANDELIERS AND BRACKETS.

advisable in this room, as there is likely to be a desk in one corner calling for a portable desk lamp or a fan, or both.

DINING ROOM.

Plan A—Place a 1-light chain pendant in the center. Equip with an art glass dome and have the lamp inside point straight down. Over the lamp inside put a prismatic reflector of a type which will give an even distribution of light over the entire top of an ordinary dining table. Avoid the use of a reflector which concentrates light in the center of the table at the expense of the edges, as the effect will not be good. A ground glass bottom on the dome is desirable.

Plan B—Use Plan A, but equip the lamp inside the art glass dome with a fluted opal cone reflector.

Plan C—Use a chain pendant, and equip with a decorated 11-inch opal dome reflector. This, of course, will cost considerably less than the art glass dome.

Plan D—Use style of chandelier indicated in Fig. 3. Equip the center socket with an 8-inch opal dome which will distribute light well over the table for all ordinary occasions. For lighting up the room more thoroughly, equip the chandelier arms with bare, frosted lamps. The lamps on the arms are seldom needed.

KITCHEN.

Plan A—Place a pendant or bracket with lamp socket pointed straight down, 7 feet above the floor, a little to one side of the sink, and equip with a fluted opal cone reflector. In some other part of the room, where it will cover range and table, place a pendant with a lamp above 7 feet from the floor. Control both lamps with one switch, and use chain pull sockets for turning off one lamp when not needed.

Plan B—Place one lamp in the center of the ceiling. Control by a switch and equip with a reflector which will give the maximum intensity obtainable in the direction of sink and range. In the ordinary 10-foot square kitchen, this reflector in the present state of the art will be a prismatic reflector, which gives an intensity of over 30-candle-power at the desired angle. The fluted opal cone and the opal dome reflectors are also good ones to use in such a location.

PANTRY.

Plan A—Place one bare lamp on a drop cord 6½ feet above the floor.

Plan B—Place the lamp at the ceiling, control it by switch and equip it with a fluted opal cone reflector.

BED ROOMS.

In bed rooms, the owners are likely to balk at the cost of providing enough outlets to give the most perfect bed room lighting. In outlining the following different schemes for bed room lighting the author began with the simplest and cheapest and from that went step by step to more expensive and more satisfactory plans. Although some of the plans proposed may seem crude, all realize the desirability in many cases of keeping down the cost of installation. The owner, if left to himself, and the wiring contractor, will frequently provide well for the rest of his house, but put the bed rooms off with a single bare lamp on a few feet of flexible cord.

Plan A—Where one outlet only is allowed, place a 3-lamp wireless cluster on the ceiling in the middle of the room. This will give an outlet to which various portable devices can be attached and the curling iron heater, heating pad, etc., will be taken care of. For the lighting of the room as a starter, use a portable wall bracket which can be hung on a hook anywhere in the room, and attach it by means of flexible cord and an extension plug to the wireless cluster on the ceiling. The portable wall bracket used should in general form resemble the ordinary permanent bracket with the lamp mounted at an angle of about 25 degrees from vertical. Equip the portable bracket with a fluted opal cone reflector or a prismatic reflector giving a fairly wide distribution. The portable wall bracket will probably most of the time be hung over the center of the dresser mirror. It can also, at a moment's notice, be placed anywhere else in the room or hung low for reading purposes. If provided with chain pull socket, it can be hung over the bed within reach of a person in bed, for use in the night. The portable bracket is somewhat of a makeshift, but it comes nearer to giving light in all places that light is likely to be wanted in a bed room than any arrangement not providing three or four outlets.

Plan B—Same as Plan A, but add a drop cord in the middle of the room and equip the lamp with an opal or prismatic reflector. Also mount bare, frosted lamps each side of the dresser mirror and attach these by flexible cord and extension plug to the receptacle at the center of the ceiling. This plan will give as completely lighted a bed room as one could wish, but, of course, has the objection of considerable exposed flexible cord. This, however, is not as serious as might be thought.

Plan C—Place a 1-lamp pendant in the center of the room with a prismatic reflector and a 1-lamp bracket of the style indicated in Fig. 5 over the center of the dresser mirror. This will call for two permanent fixtures, the lamps on both of which will, as a rule, be used at the same time. It will, therefore, be advisable to provide some of the well-known means for getting current for heating devices from one or both of these outlets without disturbing the lamps and reflectors on the fixtures. This can be done by providing a flush wall receptacle close beside the fixture outlet, or by using a type of canopy receptacle or tap recently put on the market. One lamp over the center of the mirror is sufficient for most purposes except shaving, consequently where this Plan C is used a portable shaving mirror with lamps on each side must be hung up somewhere in the room and attached by extension plug and cord to one of the outlets when needed.

Plan D—Place a bracket each side of the dresser of the general style shown in Fig. 4. Use frosted upright lamps. Place a 1-lamp pendant with lamp 6½ ft. above the floor in the center of the room for general lighting and reading. The lamp bulbs each side of the dresser should be 5 feet 9 inches above the floor. This will be a little high to provide the best shaving light, so that if shaving is to be done a portable shaving mirror with a lamp on each side can be hung at some convenient point in the room and attached to one of the dresser bracket sockets.

Plan E—This plan represents the most perfectly lighted bed room, but calls for more outlets in each bed room than the average owner of a $3,500-residence is willing to pay for. Place a short 2-lamp chandelier of the general style shown in Fig. 2 in the center of the room with lamps 7½ feet above the floor controlled by a switch. Equip the lamps with 7-inch opal dome reflectors, or prismatic reflectors giving an approximately similar distribution. Place a bracket of the style indicated in Fig. 4 each side of the dresser with the lamp bulb 4 feet 8 inches above the floor, using frosted bulb lamps with no shades. Place a bracket of the style indicated in Fig. 5 over the center of the dresser mirror, and equip with fluted opal cone reflector or prismatic reflector, giving similar distribution. Place over the head of the bed a bracket of the style indicated in Fig. 5. Equip with chain pull socket and a concentrating type of prismatic reflector.

HALLWAY AND STAIRS.

Arrangements of halls and stairs differ so much that general rules are hard to formulate. It is usually advisable to have one lamp half way up the stairs, where it will light both up and down the stairs, and control this by a 3-way switch at the top and bottom of the stairs. The glassware used on the stair lamp must depend altogether on the direction in which the light is wanted. If it is placed very high on the ceiling of the second floor (as it must be in some cases), a concentrating prismatic reflector should be used. If it is placed on the stair landing to light both up and down, a sand-blasted ball is best.

BATH ROOM.

Plan A—Place one lamp at the ceiling with fluted opal cone reflector and control by a switch.

Plan B—Place one lamp on a pendant 6½ feet above the floor with chain pull socket and a prismatic reflector giving very wide distribution.

BASEMENT.

Plan A—Place two or three lamps with flat porcelain reflectors at points they are likely to be needed. Control all lamps with one switch and use turn-down lamps.

PORCH.

Plan A—Place one lamp in a 7-inch opal dome reflector over the front door. Control by a switch inside the house. In some cases the owner will wish to have this lamp controlled also from the outside, in which case 3-way switches can be used. Whatever is done, the lamp should be controllable from the inside for obvious reasons of safety and convenience.

HEATING CIRCUIT.

No new home should be wired these days without a special heating circuit of No. 8 or 10 wire ending in plug receptacles of ample capacity in the kitchen, and in one similar plug receptacle in the dining room. The dining room receptacle can usually best be placed in the baseboard near the sideboard, although some prefer to place it under the dining room table. Receptacles designed especially for the heavy current used by some heating devices should be used. The majority of receptacles used for other purposes are too light. The small heating devices used elsewhere than in the kitchen and dining room can be attached to ordinary lamp sockets.

GENERAL NOTES.

The living room and library chandeliers, although controlled by wall switches, should be equipped with chain pull sockets so that some of the lights can be turned off at the chandelier without an unreasonable reach by a short person. This obviates the expense of a double circuit to a chandelier. In the dining room, if desired, the expense of a wall switch can frequently be done away with if a chain pull socket is used on the dining room fixture, since it is usually easy to locate the dining room fixture in the dark by virtue of the fact that it is over the middle of the table.

Prismatic reflectors are made to give such greatly different forms of light distribution that they should always be selected either by their photometric curves, which are frequently obtainable from the manufacturers, or by actual trial.

DRAWING UP SPECIFICATIONS.

After we have decided upon the exact location and equipment of fixtures, it is important to have some system whereby specifications for the work can be drawn up rapidly and systematically, so that the necessary information and instructions can be put in the hands of workmen, contractors, and bidders. Even where a central station company does the wiring itself, the man who plans the job must have some way of putting down his ideas so that

others can follow them easily. The first thing to be done is to take a set of floor plans of the house and mark upon these plans the location of the various outlets, indicating the number of sockets to be provided at each outlet. In order to avoid the great amount of work which would be necessary to draw up complete typewritten or manuscript specifications for each room, a table or blank schedule of the form shown in Fig. 6 will be found of great value. This table provides for most of the common items in connection with any ordinary job, and the extraordinary things can be taken care of under remarks' column. It is a quicker and easier job for the contractor and workmen to get information off such a schedule than from any other form of specification, and at the same time the schedule can be made out very rapidly. In the column specifying the kind of fixture to be used, reference can be made to a rough sketch indicating the general arrangement of sockets on the fixture; or if selection of the fixture is made at the time the schedule is drawn up, the maker's catalogue number of the fixture can be used instead of a sketch number. The accompanying schedule is filled out for a part of the wiring and lighting of the proposed house, using the plans marked A in the foregoing portions of the paper. It will not always be necessary to fill out all of the items on this schedule, nor is it necessary that all of the schedule be filled out at once. That portion necessary for the wiring can be filled out when the wiring bids are to be received, leaving other portions until later.

In planning the location of fixtures and especially that of wall brackets in bed rooms, it is desirable to have some means of showing quickly the probable location of furniture, and of trying the furniture in different locations. In going over the lighting plans with the owner, an excellent plan is followed by the Cleveland Electric Illuminating Company. Blocks of the sizes of various pieces of furniture have been made up to the same scale as the architect's plans so that they can be set on the plans and the owner of the house can decide intelligently where to locate the furniture.

Against possible changes in location of furniture there is no safeguard, except the possible inconvenience of such changes and the use of lamps mounted directly on the dresser. Where such work is being done it is a good plan to have blank schedules printed on tough, thin bond paper from which blue prints can be obtained after the original blank is filled out. Where not enough work is done to justify this expense, a blank schedule drawn up on tracing cloth can be used to make blue prints and the blue prints can be filled out in black ink or red pencil.

ROOM OR LOCATION	No. of Outlets	No. of Fixtures	No. of Lights Per Outlet: Gas	No. of Lights Per Outlet: Electric	Height of Outlet	Height of Socket	Style of Socket	Kind of Switch	Style of Fixture: Sketch No.	Style of Fixture: Catalogue No.	Catalogue No. of Glassware	Diameter Holders	Lamps: Number	Lamps: C.P.	REMARKS
First Floor															
Living room	1	1		3	Ceiling	6'10"	Pull	Push	1		1*2641 2*3150	1 5/8" 3 1/4"	1 2	16 8	
" "	1	-	-	-	Base board	—	—	—	-	-	—	—	-	-	Baseboard receptacle
Dining "	1	1	-	1	Ceiling	6' 0"	Pull	Push	-	†245	*7381	2 1/4"	1	16	
Library	1	1	-	2	Ceiling	6'10"	Pull	Push	2		*2621	1 5/8"	2	8	
"	1	-	-	-	Base board	—	—	—	-	-	—	—	-	-	Baseboard receptacle
Kitchen	2	2	-	1	Ceiling	7' 0"	Pull	Snap	-	†090	*4184	2 1/4"	2	8	
Pantry	1	1	-	1	"	6'10"	"	—	+	0	—	—	1	4	†Drop cord

Note: #Catalogue of X Glass Co. *Catalogue of Y Glass Co. †Catalogue of Z Fixture Co.

Fig. 6.—Blank Form for Electrical Supply Data.

Illumination.*

By Prof. W. S. Franklin and Prof. William Esty.

The Problem of Illumination.

A ROOM may be said to be well lighted when the eye is easily able to distinguish, in minute detail of perception, the various objects in the room. Completeness of visual perception depends upon three conditions, namely, (*a*) a sufficient brightness of the illumination; (*b*) a proper location of the light sources, so as to bring out that combination of soft shadows which is so essential to the perception of form, and (*c*) a proper composition of the light so as to bring out those physical differences in objects which the eye perceives as variations of color. The composition of light refers to the relative intensities of the various wave length components of the light.

A room may be intensely illuminated by a single arc lamp, but such illumination is ineffective even when the eye is shaded from the direct light of the lamp, because the excessive harshness of the shadows renders the perception of form almost impossible; on the other hand, a sufficiently intense and properly distributed light, which contains certain wave lengths in great excess, may be ineffective because of the unusual or weak color effects produced thereby. For example, the light of an ordinary kerosene lamp is very deficient in the shorter wave lengths; these shorter wave lengths have much to do with the bringing out of blue and violet tints; and, consequently, a deep blue or violet piece of cloth appears almost black by kerosene lamp light. False color values are produced in a very striking way by the light from the mercury vapor lamp on account of the almost complete absence of the longer wave lengths (red) in the light from this lamp. The brilliant white light of the carbon arc lamp, on the other hand, contains all wave lengths in about the same proportion as sunlight, and all colors show up well by the light of such an arc lamp.

Glare.

Excessive contrast of light and shade in the field of vision tends to hinder visual perception. The eye adapts itself automatically to the brightest lights in the field of view and all perception of detail in the shadows is lost. This blotting out of detail in the shadows by excessively brilliant lights in the field of vision, which is called glare, is especially marked when the field of vision in-

* Condensation of a portion of a chapter of Franklin and Esty's "Elements of Electrical Engineering," now in press.

cludes a bright, unshaded lamp. The explanation of glare is as follows: In the first place, the pupil of the eye contracts greatly when there is a bright light in the field of vision and this contraction lessens the effective brightness not only of the "high lights," but also of the deep shadows; in the second place the sensitiveness of the retina seems to be greatly reduced in bright light, and while this reduction of sensitiveness may leave the eye able to perceive detail in the more brilliantly illuminated portions of the field of vision, it tends to obliterate all detailed perception in the shadows; and in the third place an intense beam of light entering the eye from a bright source illuminates the whole interior of the eye, just as a beam of sunlight entering a window illuminates a room, and this diffused light in the eye illuminates and excites the portions of the retina where the images of the shadows fall, and thereby tends to obliterate all detail of perception. An interesting case involving excessive contrast is that in which a workman at a loom, for example, has his immediate work illuminated to a fair degree of brightness, while the remainder of the room is left in darkness. If the workman could keep his eyes fixed upon his work incessantly, it is conceivable that this kind of illumination might be satisfactory; but the eye moves about in spite of everything one can do, and under the assumed conditions the workman would be unable to see when he glanced about the room, and he would be blinded when he glanced at his work. To avoid this impracticable situation a general illumination of the room is necessary.

It is very important in arranging for the illumination of a room to place the lamps outside of the field of vision, if possible, so that no light can enter the eye directly from the lamps and render the eye insensible to the delicate shading of surrounding objects. The excessive discomfort that is produced by the glare of improperly located lamps, such for example as the exposed footlights of a poorly arranged stage, is due not only to the physical pain that is associated with long-continued looking at a bright light, but more especially to the incessant strain of trying to peer into the dark region beyond.

Where a lamp cannot be removed from the field of vision the bad effects of glare may be greatly reduced by enlarging the effective luminous surface of the lamp by means of a translucent globe. A translucent globe always absorbs a considerable portion of the light of a lamp, but the effectiveness of the globe in eliminating glare is due primarily to the fact that a given amount of light coming from a small brilliant source produces a much greater glare than the same amount of light coming from a large faint source.

DIM LAMPS VERSUS BRILLIANT LAMPS.

A much more satisfactory distribution of light in a space to be illuminated may be obtained by using several lamps of moderate brightness than by using one or two lamps of great brightness. Thus very bright lamps are not suitable for illuminating small rooms because the one or two lamps required to produce the desired quantity of light give a very unsatisfactory distribution, and the number of lamps required to give a satisfactory distribution would produce an excessive amount of light. To give a satisfactory distribution of light over the field of vision in the lower portion of a room, very bright lamps should be raised to a considerable height overhead. In general, therefore, very bright lamps are unsatisfactory except for lighting very large high rooms and for street lighting; such lamps may, however, be used satisfactorily in moderately small rooms when the indirect system of illumination is employed. In this system all of the direct light from the lamp or lamps is thrown upon the ceiling of the room and the diffused light reflected from the ceiling produces a beautiful soft illumination in the lower portion of the room.

INFLUENCE OF ABSORPTION UPON ILLUMINATION.

An illuminated surface, such as the wall, ceiling or floor of a room, or the surface of an object in the room, absorbs a definite fractional part of the light which falls upon it. This fraction is called the coefficient of absorption of the illuminated surface. The lamps in a room emit a given flux of light and at the instant the lamps are turned on the intensity of the illumination in the room is quickly increased by repeated reflections of the light from the illuminated surfaces until the rate of absorption of light by the illuminated surfaces is equal to the rate of emission of light by the lamps. Given, for example, two rooms, A and B, illuminated by the same number of lamps. Suppose that the two rooms have the same area of walls and objects to be illuminated, but suppose that the illuminated surfaces in room A absorb an average of 40 per cent of the light which falls upon them, whereas the illuminated surfaces in room B absorb an average of 80 per cent of the light which falls upon them. In both rooms the amount of light emitted by the lamps and absorbed by the illuminated surfaces is the same, but this absorbed light is only 40 per cent of the mean intensity of illumination in room A, whereas it is 80 per cent of the mean intensity of illumination in room B; therefore, the mean intensity of illumination in room A is twice as great as it is in room B. In general the total flux of light required to produce a given mean intensity of illumination in a room is proportional to $a\,b$, where a is the combined area of all the surfaces to be illuminated and b is the mean coefficient of absorption of these surfaces.

FLUX OF LIGHT REQUIRED FOR EFFECTIVE ILLUMINATION.

The total flux of light, in spherical candles required for the effective illumination of a given-sized room depends upon the manner in which the light is distributed, upon the composition (color) of the light, and upon the mean coefficient of absorption of the illuminated surfaces as pointed out above. Interior lighting is usually accomplished by lamps which give a soft yellow light, the lamps are usually distributed overhead so as to be as much as possible out of the field of vision, and walls and ceiling are usually yellowish-white. Under these conditions about 0.2 of a spherical candle is required for each square foot of floor area to give a degree of illumination that would be considered satisfactory in a reception room or in a lecture hall. If the ceiling is very high a greater candle-power is required inasmuch as the area of the walls is increased. If the ceiling and walls are very dark, if they are made of stained oak or cherry paneling, for example, effective illumination may require 0.4 or 0.5 of a spherical candle per square foot of floor area.

LAMP EFFICIENCY.

In practice the efficiency of a lamp is specified by giving the watts consumed in the lamp per spherical candle of light flux emitted. Thus the carbon filament glow lamp of the kind that is at present most widely used consumes about 3.6 watts per spherical candle. The actual efficiency of a lamp, however, is the ratio of the light energy emitted by the lamp to the total energy supplied to the lamp. The actual efficiency is greater the smaller the so-called efficiency in watts consumed per candle.

Ängstrom has found that that part of the horizontal radiation of a Hefner lamp which lies within the limits of the visible spectrum represents a flow of 8.1 ergs per second across one square centimeter at a distance of one meter from the lamp, so that one spherical hefner corresponds to a flow of $4\pi \times 100^2 \times 8.1$ ergs per second, or 0.102 watt. This corresponds to 0.115 watt for one spherical candle. The power value of the spherical hefner (or candle) depends, however, to some extent upon the composition (color) of the light. The value of 0.115 watt per spherical candle applies to the orange-colored light from the Hefner lamp, and this value can be considered only as an approximation to the power value of one spherical candle of yellowish light, or of pure white light, or of bluish light.

Taking 0.115 watt as the approximate power value of one spherical candle, it follows that the ordinary carbon filament glow lamp which takes 3.6 watts per spherical candle (about 3.1 watts per mean horizontal candle) has an actual efficiency of about 3 per cent, an ordinary enclosed arc lamp which takes 2.2 watts per spherical candle has an actual efficiency of about 5.2 per cent, a luminous arc lamp which takes 1.2 watts per spherical candle has an actual efficiency of about 9.6 per cent, and a mercury vapor lamp which takes 0.6 watt per spherical candle has an actual efficiency of about 19.2 per cent.

EXAMPLES ILLUSTRATING CONICAL INTENSITY AND SECTIONAL INTENSITY OF LIGHT.

Example 1.—A given beam of light, consisting of parallel rays and having a sectional intensity of 300 luxes, passes through a lens of which the focal length is 50 cm., and becomes a conical

beam of which the conical intensity is 75 hefners. This is evident when we consider that the conical beam has, at the lens, the same sectional intensity as the given beam, namely, 300 luxes; that is, a sectional intensity 300 times as great as a beam from a Hefner lamp at a distance of 100 cm. from the lamp, or the same sectional intensity as a beam from a 75-hefner lamp at a distance of 50 cm. But two conical beams which have the same sectional intensity at the same distance from the apex or focus have also the same conical intensity.. Therefore, the conical beam of light formed by the lens in this example has a conical intensity of 75 hefners.

Example 2.—The modern searchlight presents some very interesting features in regard to conical intensity. To understand the following numerical example one must remember that light which emanates from a point in the focal plane of a lens is transformed by the lens into a beam of rays which are all parallel (ignoring errors of aberration and astigmatism) to a line drawn from the point to the center of the lens, so that the light which emanates from a small luminous surface in the focal plane of a lens is transformed by the lens into a series of parallel beams which, at a great distance from the lens, lie within the cone formed by lines drawn from the periphery of the luminous surface to the center of the lens.

The light which the powerful arc lamps of a given searchlight sends towards the search lamp lens has a conical intensity of 10,000 candles. The lens has a diameter 500 times as great, or an area 2,500 times as great, as the actual luminous surface of the lamp, and the searchlight beam has a conical intensity of 2,500 × 10,000, or 25,000,000 candles. This is evident when we consider that the cone of rays which the lamp sends to the lens is 2,500 times as large as the cone which, at a great distance, contains the searchlight beam, and that all of the light in the larger cone is concentrated in the smaller cone. Anyone who considers this example carefully will realize the important fact that the candle unit as used in photometry is not a unit of quantity but a unit of intensity.

Properties of the Series Transformer.

By W. B. Gump.

It is believed by the writer that the characteristics of the series transformer are not so generally known that a few facts relating to it would be out of place, and to those who are concerned with this very useful piece of apparatus the following may, it is hoped, be of some benefit.

In order to have a clear conception of the action of a series transtormer, it may be well to point out the more general features which it possesses, and to compare these with the corresponding properties of the potential transformer. Suppose we consider a circuit as shown in Fig. 1, in which current flows through the primary, *P*. The value of this current will necessarily be determined by the load on the line, *L*, irrespective of

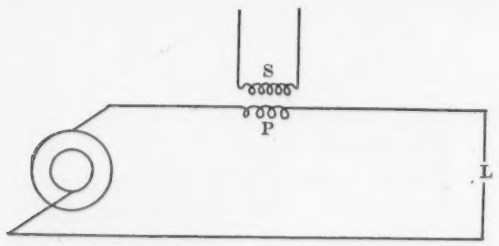


FIG. 1.—PLAIN SERIES TRANSFORMER.

the condition of the secondary, which might be either short-circuited or entirely open. Observe now the condition shown in Fig. 2, that of a shunt transformer in which the primary is connected directly across the mains, the current being governed by the impedance between *M* and *N*. The current depends upon the load on the secondary, *L'*, and not upon the line load, as in the first case.

Let us now assume that the secondary in Fig. 1 is on short-circuit, and for simplicity, that there is no magnetic leakage between the coils. At the moment that current is started, flux is set up in the primary. This flux produces an e.m.f. in the secondary which sets up a current opposed to that flowing in the primary. The result is that the flux threading the coils will be reduced to a value which will produce only a sufficient voltage to cause current to flow through the secondary resistance, thus restoring approximate equilibrium between the primary and secondary currents. Thus the magnetomotive force of the primary current is less than that of the secondary current by an amount such that the flux produced thereby generates the voltage required to send the secondary current through the resistance of

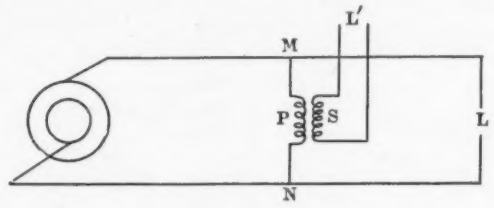


FIG. 2.—PLAIN SHUNT TRANSFORMER.

the secondary circuit, the vector sum of the secondary current and the magnetizing current being equal to the primary current.

Consider now that the secondary is closed through a high resistance. There will be a decrease in the secondary current, and hence a decrease in the ampere-turns, allowing the primary ampere-turns to become effective in producing a greater flux, which will cause the secondary e.m.f. to increase. The increase in the secondary e.m.f. will increase the current in the secondary, which in turn will create an opposing magnetomotive force, the value being just sufficient to allow the excess of primary magnetomotive force to produce the flux to cause the current in the secondary to flow. A further study of these facts will reveal the fact that an increase in the magnetizing current due to an increase in the secondary resistance affects the current ratio between the primary and secondary.

In order to perform its work perfectly, a series transformer should maintain a constant ratio between its primary and secondary currents throughout its full range of load. Such a condition can only be approached, and not absolutely reached, since the magnetizing current becomes a formidable factor in preventing a constant ratio. From these facts it is seen that the first essential in a series transformer is a minimum magnetizing current. This is accomplished in commercial current transformers by having an abundance of iron in the core, thus working the iron at a very low magnetic density—only a small fraction of that of the potential transformer—permitting the current ratio of the primary to the secondary to vary approximately in inverse ratio to the number of turns. The iron is worked considerably below the "knee" of the B.-H. curve, allowing a considerable range of load for ammeters and wattmeters to be operated on the secondary.

Since the ratio between the primary and secondary is not con-

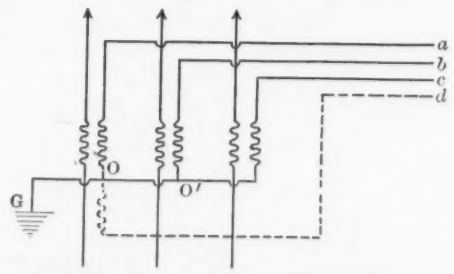


FIG. 3.—SERIES TRANSFORMERS IN THREE-PHASE CONNECTIONS.

stant for all loads, instruments which are to be operated on the secondary of current transformers are calibrated with the transformer throughout the working range of the instrument, making the scale divisions correspond to the true reading in amperes.

It was stated that in order to reduce the magnetizing current to a minimum, the iron is worked at a low magnetic density. Due to the fact, therefore, that a large cross-section of iron is used, the secondary of a current transformer should always remain closed, for the reason that when there is no current in the secondary there is no opposition to the primary magnetomo-

tive force, which may produce a large flux to cause the voltage on the primary to rise to an enormous value, often to thousands of volts. This condition produces serious heating of the transformer as well as great strains upon the insulation, which has in some instances been punctured by the extreme voltage produced.

From the foregoing it is readily understood that a current transformer differs quite widely from a potential transformer, the latter maintaining a practically constant secondary voltage irrespective of load on the secondary, while the former must of necessity change its secondary voltage in order to change its secondary current. In the former we have an approximately constant current ratio governed by the number of turns the secondary bears to the primary. In the latter we have an approximately constant voltage ratio governed by the number of turns of the secondary to the primary. In this we have a striking relation, and as the respective names imply, one transforms current while the other transforms e.m.f.

Having considered the nature of current transformers, the conditions will now be shown which exist in connection with two or more current transformers operating together on a polyphase circuit. Consider first the application of three series transformers as shown in Fig. 3, which is quite common in three-phase generating systems of from 3,000 to 12,000 volts. If all of the secondaries are not arranged in the same direction, it will be found that the phase relation between the first and second, and between the second and third, respectively, is 60° instead of 120°. As the phase relation does not alter the readings on ammeters, such an arrangement of connections is permissible. To obtain a phase difference of 120° between each, it would be necessary to reverse one of the secondaries, such as

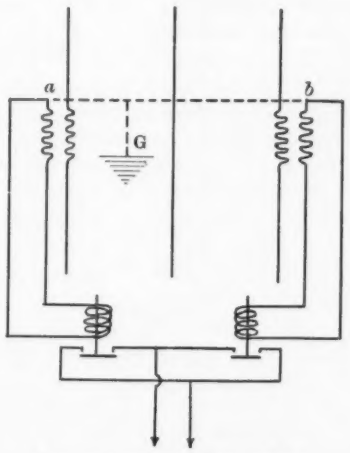


FIG. 4.—DOUBLE COIL RELAY.

O d, shown by a broken line. In either a delta or star arrangement it becomes necessary to reverse one transformer with respect to the others when 120° difference of phase is required. When operating three-phase wattmeters, the middle transformer is nearly always dispensed with, since but two are necessary. In such a case a third phase is introduced by reason of a common return wire being brought to the point *O'* from the junction of the other two phases, creating three phases differing from each other by 120°.

In connection with overload relays, three transformers are often recommended, but in the majority of cases two are sufficient to give entirely satisfactory results. When two transformers are employed on a relay circuit, the connections shown in Fig. 4 will be found to give satisfaction, as each transformer has its own trip coil, and an overload on any phase is sure to cause one or the other of the trip coils to actuate the switch. If the secondaries are to be grounded they should be connected as shown by *a b*, and thence to the ground, *G*.

A single coil relay is shown in Fig. 5 in which the current transformers have their opposite terminals connected. To these connecting wires a trip coil, *T C*, is joined. The phase relation which exists between the two secondaries may be seen from Fig. 6. Here the secondaries, *S* and *S'*, tend to operate in parallel. When normal current flows in the line conductors, *a* and *c*, a current will circulate in the trip coil, *T C*, but will not be sufficient to actuate the trip coil. Suppose a short-circuit to occur between *O* and *C*. The secondary, *S'*, will become overloaded. Its e.m.f. will, therefore, rise to a value above that of the transformer, *S;* this will tend to reverse the current in *S*, which in turn will allow the primary flux to raise the e.m.f. to that of *S'*. The value of this voltage will cause the additional current to overload the trip coil and actuate the switch.

The current in the trip coil will not be twice the current in either phase *O a* or *O c*, but will be the geometrical sum of

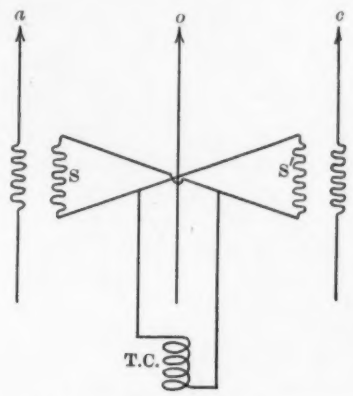


FIG. 5.—SINGLE COIL RELAY.

the currents at 120° difference in phase, or $\sqrt{3}$ times the current in one leg. Thus if the current transformers, *S* and *S'* are wound to give 5 amp. on their secondaries with normal current in the primary, the current in the trip coil will be $\sqrt{3} \times 5 = 8.66$ amp. The tendency of the two transformers connected as shown is to divide the current equally between them, regardless of the phase on which an overload takes place. It is possible, however, for the current in the trip coil to become greater from an overload across *a c* than one across *O c* or *O a*. The impedance in the trip coil will change with change of load, and is a significant factor in opposing the rise of pressure in the two transformers. The opposing force of the trip coil is in every case reacted upon by an effort on the part of the transformer voltage to rise to a higher value to meet the impedance e.m.f. A balance is finally maintained which allows just enough current to flow to overcome the total impedance created.

In connecting power factor meters, care is necessary in order that the current transformers do not produce a geometrical increase in current. If, when connected, the current is found to bear the $\sqrt{3}$ relation, the terminals of one transformer should be reversed.

Although the current transformer is highly useful, and its development has reached a point of great accuracy, there remain some defects which cannot be completely overcome, except by some type of compensating device which from its own character is inaccurate. The impedance produced by the instruments themselves when connected to current transformers, is for the most part corrected by the calibration in connection with the transformer. The greatest errors occur in watt-hour meters,

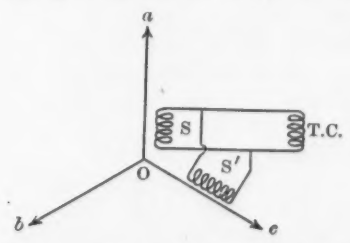


FIG. 6.—PHASE RELATION IN SINGLE COIL RELAY.

since the errors are carried along, and hence are continually increased, there being a chain of intermediate elements through which the electric energy must travel to be recorded.

Current transformers to be used in operating watt-hour meters must be designed so as to "average up" the errors according to the usual load upon the instrument. Careful design, therefore, eliminates most of the errors and permits of considerable accuracy throughout the range of load being measured.

Electric Heating.

At the Atlantic City Convention of the National Electric Light Association, Mr. James I. Ayer presented an interesting paper on residence electric heating, of which an abstract follows:

Mr. Ayer favors the introduction of electric heating devices by personal presentation, and recommends for the use of solicitors lists of meter readers' routes and a card catalogue divided into sections for a record. Circulars, or a typewritten letter with circulars, should be sent out a few days in advance, announcing a proposed call and its object. Articles should be left on trial after fully explaining their operation, and should be accompanied with complete printed instruction. The length of trial will depend upon the device; for flatirons this should be about 30 days, and in some cases sufficient time should be allowed for the customer to note the effect on his bill from the central station. The customer should be called upon at the expiration of the trial period, instead of being communicated with by mail. It is a good practice to invite prospective customers to a practical demonstration of electric heating, such as cooking a light lunch to be served to them.

The electric iron is an ideal article for the introduction of electric heating. For laundry use they are required from three to five hours per week, costing from 15 to, at most, 50 cents per week; the latter being for the longest period at a 20-cent rate. It is fair to say that at the average rate the average family ironing can be done at from one dollar to one dollar and twenty-five cents per month. Using the flatiron as an opening wedge it is well to follow with circulars or folders describing such articles as water cups which will furnish a pint of boiling water in seven or eight minutes in the smaller size, or a quart in a larger size in ten minutes. Either will supply enough for a cup of tea in three or four minutes, and for shaving in less time. These articles are invaluable in the sick room, and for use in hundreds of ways. Improvements in these devices prevent their burning out or overheating in the event of boiling dry. This result is obtained by the circuit being broken automatically if the temperature rises a few degrees above the boiling point.

An electric heating pad can always be placed in a home where there is use for a hot water bottle. Its superior merit is immediately appreciated on the briefest investigation. Aside from its usefulness in illness, it is much used by the aged as a foot-warmer. A naval officer said he had many nights walked the bridge with a pad under his coat, comfortable in bitter weather, in spite of side remarks about "a monkey on a string."

The nursery milk warmer performs its work by electricity more uniformly and perfectly than is possible with any other method and in a shorter time. An important feature is that the time required to heat it throughout to an even temperature is less than three minutes, making the period so short after the demand is made that peace is certain. Its operation and sanitary character produce universal commendation from physicians. These devices are furnished with a socket plug arranged to receive the lamp which it displaces in the fixture, that is lighted when current is on the milk warmer.

Electric curling iron heaters are welcomed in many homes. For light cooking and the dining-room there are many useful articles. The chafing dish has many accomplishments to its credit. It can perform nearly all the operations of cooking required in homes, but of course in some cases not on the same scale as to quantity, and only one operation at a time, yet its possibilities are limitless when electrically heated. It can bake, boil, fry, stew and toast; is under perfect control, and always performs the same under like conditions, because its heat supply is a known quantity. It is a simple matter to cook and serve a good American breakfast for three, of a cooked cereal, eggs poached, boiled, fried or scrambled, with toast, in thirty minutes with a chafing dish at the cost of 250 watt-hours, and coffee can be made for 100 watt-hours more; a total of from three to four cents at the average residence rates. The stove which operates the chafing dish makes with a kettle a most desirable combination for the tea table, and with a coffee percolator in place of the kettle, meets the requirements of the breakfast table.

Chafing dishes, tea kettles and coffee urns can be had with heaters attached or separate in a variety of grades and designs, and there is no other method so safe, simple or as cheap for performing similar service in the dining-room. The cost for energy for performing any single operation with any of these devices is more often one cent or less than more, and never exceeds three or four cents.

For equally useful devices performing much the same work and more, in the dining-room or kitchen, we must remember the water cups previously mentioned come in as a part of the list, because they can be used for making coffee or tea, or boiling of any sort. In one case they are used for cooking French-fried potatoes. This type of heater is also made to form a combination of double boiler or cereal cooker, egg boiler, steamer, as well as a plain boiler.

Disc heaters, or stoves with utensils, such as saucepans, tea kettles, coffee pots, cereal cookers, vegetable boilers and the like enable the housewife with, say, two stoves and two or three utensils to do all the necessary cooking for light meals, in the dining-room if she pleases, within the limits of cost previously mentioned. Stoves or disc heaters should always be supplied with utensils made for them of suitable proportions and with perfectly flat bottoms.

For general cooking there are available individual cooking devices in all sizes required for the largest household; also ovens, plate warmers, broilers, griddles, waffle irons, frying kettles, etc. Demands for general cooking will be to fill the place now occupied by gas stoves, which, except in apartment houses are largely summer workers. Considering for the present those cases where the principal use is in summer, it is customary when using gas stoves to operate the coal range one or two days each week for supplying hot water for washing and the bath, and of course cooking at the same time, and this reduces in many cases the demand for service to perhaps six days each week.

Experience has shown from a great variety of sources that the number of watt-hours per meal per person may safely be taken at 300 or 900 per day per person. If, however, we allow one kw-hour per person, we have 30 kw-hours for a month, which at a five-cent rate is $1.50, or for a family of four $6.00 per month; or at a three-cent rate for the same family, $3.60 per month. While these figures are absurdly low to-day for lighting rates in residences, there are many cases where the service may be given from separate service wires at a satisfactory profit.

By careful comparison it has been determined that in cooking an equivalent cost for $1 gas is 2½ cents per kw-hour, and while electric cooking is widely practical at a higher rate, it will demand from five to three-cent rates to make it an important competitor to gas. Gas, however, occupied a broad field at a much higher price than coal, due to its advantages, and electric methods make it possible to secure equal results because of the many advantages possessed by the newer method over the old.

For heating the general water supply a kitchen boiler of the usual type is used varying in capacity from ten to thirty gallons, and supplied preferably with a heater contained in the boiler of a maximum of 2,000 watts, which may be reduced to 1,000 or 500 watts by a controlling switch. Such a boiler should be jacketed with ordinary pipe covering and with care is not necessarily an excessively expensive luxury. A ten-gallon boiler can be heated to 150° F. with approximately 2½ kw-hours, which will answer a very considerable demand throughout the day from a jacketed boiler of that capacity.

For bath water, heaters are supplied to place in the tub and if of 2,000-watt capacity are frequently satisfactory to those who understand in advance that it requires 2,000 watts for an hour to raise 20 gallons of water through 40° F.

Radiators for occasional use in bedrooms for short periods are practical and useful, but should have a capacity of not less than 1,000 or 1,200 watts to be at all effective, except in the case of small rooms, and should be larger for large rooms. For heating the bathroom many radiators are sold which to be effective quickly, should have 2,000 watts capacity. Of this size, if turned on for fifteen or twenty minutes, they fully accomplish their purpose, and are not expensive to the owner.

The instantaneous hot water heater to be practical requires that

current supply of 3,000 watts and more is available. While for small quantities the cost of operation is not excessive, the service demand is undesirable and it is expensive to install; and as small water heaters are so much more simple and easy to supply, they meet the demand for small requirements. The field of water heating radiators in any community, with rare exceptions, is very limited, yet the sale of these devices reaches a very considerable sum annually, and is daily increasing.

The service for a family kitchen for the average family for cooking should have capacity of about 3,000 watts, and if a kitchen boiler, bath water heater or bathroom radiator is to be included, a double-throw switch can be installed in the kitchen or other convenient place so connected as to throw off the boiler, radiator or bath circuit when the cooking circuit is required, and to avoid the necessity of extra large service capacity which would otherwise be necessary. This also suggests a method of limiting the hours for cooking service to a period when lights are not required, but it has objections, although it is practical.

The cost for heating one gallon of water to different temperatures at different rates is given in the accompanying table, the initial temperature being 60° F. and the efficiency of apparatus 85 per cent.

Total	Watts used for				Cost in cts. with current at			
Temperature	5m.	10m.	20m.	1 hour.	3c.	5c.	10c.	20c.
100°.....	1296	648	324	108	.32	.544	1.088	2.17
150°.....	2976	1488	744	48	.74	1.24	2.48	4.96
175°.....	3744	1872	936	312	.94	1.56	3.12	6.24
200°.....	4608	2304	1152	384	1.15	1.92	3.84	7.68
212°.....	4992	2496	1248	416	1.25	2.08	4.16	8.32

The policy to pursue is to personally press the sale of small household devices constantly, without complicating the situation by trying to interest customers with the larger problems, until from experience with the smaller they have become prepared for further ventures. During such a period one should gain practical experience in the larger problems in his own home. The small devices will earn from $1 to $2 per month, which will cover present transformer losses and leave a profit. When business depression comes one may cut off his electric signs, but not likely a house service, which provides many conveniences besides light.

The Easiest Place to Work Central Station Economies.

By R. B. Holbrook.

There have recently appeared in the columns of the Electrical World several articles giving various hints and good advice to the management of electric light companies as to best methods of getting more business, and most of them had many good points which, if carried out where conditions would permit, would doubtless bring results. It seems strange, however, that the one place where savings can be made in 90 per cent. of the stations in this country is so seldom mentioned; where losses are to be found in many directions and some of them of considerable magnitude; namely, in the boiler-room. To enumerate, there is the loss—

1. From poor firing. You see it nearly everywhere.
2. From improper management of stokers, where used.
3. From too much air admitted.
4. From improper furnace design, especially where bituminous coal is used and particularly those coals mined west of the Pittsburg district.
5. Boilers coated with scale inside and covered with soot outside.
6. Where several coals can be obtained to select from, frequently the most economical one is not purchased.
7. Loss from leaky joints and poor pipe covering or none at all.

If these losses were followed up intelligently and persistently, it would mean no small reduction in operating expenses at the station, and in view of the fact that by an expenditure of $75 all the foregoing may be investigated, it would seem that a larger percentage of stations should be equipped along these lines. In what follows the losses above enumerated will be taken up in detail.

Poor firing is throwing in 15 to 25 scoopfuls of coal at one firing under a medium-sized boiler. Poor firing is firing most of the coal on the front half of the grate surface, especially in front of the doors. Good firing is throwing in the least amount of coal possible at each firing to maintain the pressure and give a high per cent carbon dioxide, spreading coal evenly over the entire grate surface, and firing every other door in large boilers or batteries of boilers.

It may interest some to mention that the best fireman I ever met preferred a scoop of following dimensions: Width at end, 13½ ins.; width where round part commences, 10½ ins.; length 18 ins.; weight, 7 lb. When the scoop rested flat on the floor the end of handle was 22 ins. above the floor. It was termed a No. 5. With this make of scoop this fireman could throw two-part scoopfuls of screenings so evenly that on a grate surface 5½ ft. long by 3 ft. wide (half the entire surface) no space 4 ins. by 4 ins. would be without coal.

This brings us to the question of apparatus. To ascertain the amount of carbon dioxide and other necessary determinations, to investigate the economy of the boiler-room intelligently, the following apparatus will be needed:

A set of gas analysis apparatus. The writer prefers the Orsaat.

A coal calorimeter for determining the heat value of coal. A description of one cheaply constructed appeared in the *American Electrician*, April, 1905. While not of highest accuracy, it will enable anyone to learn much about coal, and later a better instrument may me purchased if fuel bill justifies it.

A balance sensitive to one milligram with weights.

A Bunsen burner and blast lamp. Where gas cannot be obtained a gasoline lamp or burner may be substituted. There are several kinds on the market from $2 each and up.

A few No. 0 royal Berlin porcelain crucibles with covers.

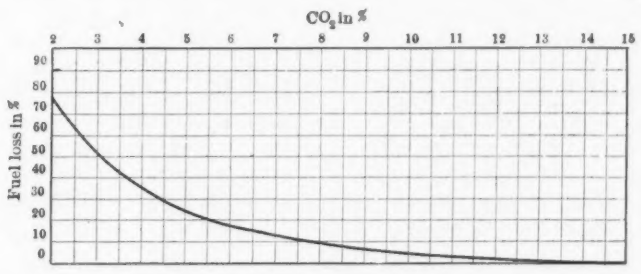


FIG. I.—LOSS CURVE.

A high temperature thermometer reading to 1,000 deg. Fahr. for taking temperature of chimney gases.

The above will cost $65 to $75. A good book giving necessary instructions for using gas analysis apparatus and much on coal analysis is "Gas and Fuel Analysis," by A. H. Gill.

After obtaining the above equipment and learning how to use it, one is ready to find out just what is being done in the boiler-room. Different methods of firing may be tried and samples of gas analyzed. With hand firing 13 to 14 per cent CO_2 can be obtained (samples of gas taken two minutes after firing) if conditions are right. If not, it may be as low as 6 or 7 per cent, and just before firing may be as low as 3 per cent. What this means is shown graphically by the accompanying curve, Fig. 1, showing loss with various percentage of CO_2. A little earnest work along the line of gas analyses will show that 19 out of 20 firemen permit too much air to pass through the furnace. Few know how little ashpit opening is sufficient. For a pointer along this line it might be mentioned that the writer has seen 900 lbs. of coal burned per hour on 33 sq. ft. of grate surface with .25 in. draft measured near the damper of a return tubular boiler. With each of the two ashpit doors, 16 x 22 ins., open 2½ ins., 13 to 15 per cent CO_2 was obtained shortly after firing, and 9 per cent just before coal was thrown in. The fuel was a low-grade Western coal containing 27 per cent refuse.

Here we might call attention to just what a boiler test should show. Mr. A. Bement, in *Enginering and Mining Journal*, Nov. 24, 1904, states:

"Coal burned under a boiler helps to discover four different things: 1. To ascertain the heat producing value of the fuel.

2, The efficiency of the boiler. 3, The value of the furnace. 4, The skill of the fireman. The relative value of each of the above cannot be determined without gas analyses and the heat value of the fuel used in addition to the usual data, viz.: Weights of water, fuel, temperatures of feed water, escaping gases, etc. Boiler tests as usually conducted give all the credit to but one of the first three items. The last one, skill of firemen, is seldom mentioned."

A book could be written on improper furnace design and not exhaust the subject. I will say in passing that as the value of firebrick furnaces and firebrick tile on the lower tubes of water tube boilers becomes better known, their use will be more common. The ordinary furnace has wasted millions of dollars worth of Western coal. A high furnace temperature is a necessity for the perfect combustion of these coals. Researches of Prof. Parr and others shows some of the reasons, namely, the high igniting temperature of the volatile part of the coal, and in Western coals the water of composition in volatilizing, doubtless lowers the furnace temperature and in the ordinary furnace keeps it so low that a part of the volatile matter escapes unconsumed. With high furnace temperature the smoke problem is not difficult to solve where automatic stokers of any of the well-known makes are used The writer knows of several plants where the gases leaving the chimney are colorless part of the time, and bluish gray most of the balance of the 24 hours. The essentials are a high furnace temperature; a roomy furnace, allowing at least 8 feet for travel of gases before striking cool boiler surfaces, and a uniform feed. To prevent smoke where hand firing is done is more difficult, owing to scarcity of skilful firemen. Under present conditions there is little incentive for men to become skilful firemen.

As to the boiler scale question, there are very few places where, by the expenditure of a comparatively small sum, boilers cannot be kept clean. In most places this can be attained by simply feeding hot water to the boilers with the proper reagent introduced regularly instead of haphazard; blowing off several times per day, and cooling down thoroughly before emptying a boiler will keep boilers clean. Where water carries a considerable amount of scale forming matter, two or more tanks (wooden ones answer every purpose) to treat it in before pumping to the boilers will solve the problem. The subject of water softening is treated in several good works on the subject.*

There is an abundance of literature on the subject, but one must have some knowledge of chemistry to read it with profit. After all, there is much in the man in charge. The writer knows of a battery of boilers that has been in service 15 years and not a dollar spent for repairs. They are in good condition today and clean. Within two blocks is another battery of boilers using water from same supply the tubes of which have been renewed twice during this period. Near by is another plant using the same water supply, the boilers of which were bagged several times. Finally new boilers were put in and they were bagged. All this happened in a few years. Neglect in blowing off regularly and cooling off before emptying were the main differences in management at these places. The water contained less than 10 grains incrustating matter per gallon. Most engineers seem to be afraid to blow off water from boilers, even where bad water is used. With a feed temperature of 200 deg. and steam pressure of 125 lbs., you can blow off 10 per cent of the water pumped to the boilers and the loss is but 1⅓ per cent of the heat absorbed by boilers. It is rare to find plants where 5 per cent of water is blow off. A quarter inch of scale will usually make much more than 1⅓ per cent difference in fuel bills. To prevent scale too great concentration of incrustating matter in water should be avoided, and frequent use of the blow off will accomplish this.

In the selection of the best fuel, price, appearance and the opinion of the fireman or engineer do not establish the real value. A coal calorimeter and a few tests will tell the facts. Working along these lines a firm recently tested five coals ranging in price from $2.30 to $2.95. With one of the coals it cost 26c. to generate 1,000 lbs. of steam. With another coal it cost but 14.6c. per 1,000 lbs. steam. The coal finally selected was not the one the fireman considered the best.

It would seem as though there is nothing to be said on the subject of losses from steam leaks except that they should be stopped. All will agree on this. Still you find them in all parts of the country—in good plants as well as those not so good. Nearly everyone knows that piping should be covered to save heat, but some keep putting off the doing.

In closing it might be well to call attention again to the fact it is only by persistent, intelligent effort that fuel bills can be reduced. One may purchase all the apparatus and books mentioned, but if they are not used intelligently there will be no reduction in fuel consumed. With the apparatus and books mentioned, plus some study and thought, a very interesting field for investigation can be quite thoroughly explored to the satisfaction and profit of all concerned. Commence making figures. What does it cost you to make 1,000 lbs. of steam? After you have learned, ask one of your acquaintances; then another. After a time more will be known about what goes on in the boiler-room. At present little or nothing is known in 98 per cent of the steam plants of the country.

*"Industrial Uses of Water," by H. De Le Coux. "Water and Its Purification," by S. Rideal. "Water Softening and Purification," by H. Collett. "Water Softening and Treatment," by W. H. Booth.

Primary Distribution at 4,600 Volts and Heating System Changes at Toledo, O.

The use of a 4,600-volt system of alternating current distribution is one of the interesting features of the Toledo Gas, Electric & Heating Company's plant at Toledo, O.

The transformers on the system are wound for 4,600 primary and 115-230 volts, 3-wire, secondary distribution. Current is generated three-phase, but the distribution is single-phase. The generators are star connected with the neutral grounded. The transformers are delta connected. In the construction unusual care has been taken to avoid trees by running the lines high. Insulators and fuses are, of course, more expensive than for the usual standard of 2,300 volts.

This company is a consolidation of the Toledo Gas Light and Coke Company, which had the artificial gas lighting in Toledo, and the Toledo Heating & Lighting Company, which was doing an electric lighting and Yaryan hot water heating business. A new steam turbine, condensing plant has been built on Detroit Avenue, two miles from the business district. All electricity will hereafter be generated at this plant. Two heating and lighting plants in the residence district will be maintained in the future as heating plants by changing the boilers into hot water heaters. In other words, the use of exhaust steam from electric generating units for heating purposes has been abandoned and hereafter the heating will be done directly from hot-water heaters and electricity will be generated by a large economical condensing plant. The chief reason for the abandonment of the old policy of using exhaust steam for hot water heating purposes is the seeming impossibility of making the heating and lighting load curves correspond. Motor-driven centrifugal pumps will be used for circulating the hot water.

The new generating station will have two 1,000-kw Westinghouse turbo-alternator units, and one of 3,000 kw. There is room for two more 3,000-kw. units. The station is about a mile and a half from the creek from which condensing water is obtained. Water is taken through an iron pipe line.

Two interesting contracts for supplying power to large factories have been recently taken. The Consolidated Manufacturing Company, an automobile factory, will take out 400 direct-current motors and put in alternating-current, three-phase motors so as to obtain a curent supply without the use of rotary converters, and also secure some reduction in insurance rates. The Pope-Toledo automobile factory, which has 500 hp in direct-current motors, will put in a rotary converter so that it can purchase power in the summer time and run its own electric plant in the winter when exhaust steam is needed for heating.

The planning of the Toledo Gas, Electric & Heating Company's new station and system was done by Mr. F. F. Van Tuyl, consulting engineer of Detroit. Mr. J. E. Lockwood, formerly of Detroit, took the management of the electric and heating departments in June, 1906.

Central Station Notes from Galveston, Tex.

Galveston is a good city from the standpoint of electric light and power earnings and volume of business transacted, although the great business activity is not apparent on most of the business streets, as it is confined largely to the water front. There are two companies doing an electric light business. The Brush Electric Light & Power Company, which was first in the field, does the greater part of the commercial lighting and power and has an income of approximately $80,000 per year. The Galveston Electric Company, which operates the street railways, also does some lighting; and the street lighting is done by a municipal plant.

Mr. J. R. Cox, manager of the Brush Electric Light & Power Company, estimates that the total receipts for electric light and power of these three concerns in Galveston amounts to

METER No. ROUT. SIZE VOL. WIRE CONS.

NAME DATE INSTALLED

ADDRESS INSTALLATION 5 C.P. Inc. Arcs

10 C.P. Inc. H.P. Motor

LOCATION 20 C.P. Inc. H.P. Motor

D. C. Fans Ac. Fans

MONTH	TEST
190	MOTH BALLS TESTED BY
MONTH	TEST
190	MOTH BALLS TESTED BY
MONTH	TEST
190	MOTH BALLS TESTED BY
MONTH	TEST
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MONTH	TEST
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FIG. 1.—MOTH BALL CARD FROM GALVESTON.

$120,000 per year, which is about $4 per capita. The Brush Company is putting about $12,000 per year into increase of plant. It enjoys a fine power business having a day power load equal to about 50 per cent of its peak load. About 2,000 horse-power in motors is connected, of which 600 horse-power is in 30-horse-power direct elevator motors. From this it is seen that Galveston is a remarkably good town for elevators, most of them being in the warehouse district. The day load at the time the Southwestern electrical convention met in Galveston last May was from 500 to 700 kilowatts.

In order that good voltage regulation might be secured on the direct current network with the fluctuations caused by the elevator load a Tirrill regulator has been installed in the field circuits of two 140-volt, 200-kw direct-connected, direct-current generators. Both of these are on the shaft of a Porter-Allen vertical marine type engine formely in the service of the Chicago Edison Company. The field current handled by the regulator in this case is about 10 amperes, which is low for this capacity of machine.

LINE AND TRANSFORMER RECORDS.

Records of pole lines and transformers are kept on a large map on one of the office walls. On this map there is a nail for each pole. Transformers are represented by tags tied by these nails. These tags have the make and capacity of the transformer on one side and a list of the connected customers on the other side. The connected load can be obtained by taking this list of customers and referring to the meter cards kept in a card index system.

MOTH BALLS IN METERS.

A practice which will strike northern central station men as unique is that of renewing the supply of moth balls in meters with as great care and regularity as the periodical test of the meter for accuracy. In Fig. 1 is reproduced the meter card used for keeping track of meters and meter tests. With the Thomson direct-current meters it has been found impossible to close up the meters so thoroughly that insects will not get into the meters and stop them in the course of time. For this reason, all these meters have moth balls kept in them, and these are replenished from time to time.

How to Meet Isolated Plant Competition.

In the "Question Box" of the National Electric Light Association, Mr. S. Morgan Bushnell answers at length the query, "What can be done to meet isolated plant competition?" as follows:

In order to meet the competition of isolated plants, or, in other words, to prevent the installation of isolated plants, it is necessary to make a careful analysis of each individual case, and this analysis should be presented to the right parties.

There are five distinct classes of people, one or more of which take up the question of light and power in a building, as follows: 1. The owners themselves. 2. The tenants of the building. 3. The agents of the building. 4. The architect. 5. The engineer or consulting engineer. The interests of these five classes should be classified as follows:

1. The owner, whose interest it is to secure the most satisfactory and economical operation of the building and whose especial point of view is that of the investor who wishes a certain net return.

2. The tenant or tenants, to whom the question is purely one involving the comparative economy of the central station versus isolated plant service and who as a rule are anxious to be relieved of the responsibility and annoyance of operating an isolated plant, provided the service can be secured from the station at approximately the same cost.

3. The agent of the building, who is primarily a real estate man, whose business is the buying and selling of real estate and the handling of properties in such a manner as to secure the best net economy from any given property.

4. The architect, whose business is to plan and superintend the construction of buildings and to whom the installation of an electric light plant, with all its accompanying detail, is a matter of considerable trouble and annoyance. The additional income the architect receives from his percentage of the cost of the plant hardly compensates him for the extra time and trouble required, as his time could be more profitably used in other directions.

5. The engineer, or consulting engineer, who is interested directly in the installation of a plant; the engineer, since it is his business to operate plants; the consulting engineer, since it is his business to plan the installation of plants.

Very frequently the reason that an isolated plant is installed is because the solicitor from the central station does not have a proper comprehension of the different relations which these different classes have to the building in question. Frequently the solicitor will spend days of valuable time arguing the question of plant versus central station service with a consulting engineer whose mind had already been made up and whose only motive in taking the matter up with the central station agent is to secure data from which to present his case to the owner or the architect.

On the other hand, other buildings have been lost to the central station simply because the solicitor assumes that the attitude of the architect is a hostile one, and that he is not to secure a fair hearing. The experience of the writer is that the best architects are honestly desirous of securing what is most economical, all things considered, for their clients, and if they advocate the installation of an isolated plant, it is simply because they are influenced in their opinion by the representations made to them by engineers and electrical contractors who are in favor of the plant. It should be borne in mind by the solicitor for the central station that while he may present arguments in favor of central station service, there are many other interests whose representatives are going daily into the architect's office and are urging the reverse proposition. Every dealer in electrical supplies, every consulting engineer, every engine and dynamo contractor is urging on the architect the advantage of an independent isolated plant and as a result it is hardly to be expected that the dictum of the central station solicitor be accepted without question. But there are a great many central station solicitors who, while they will spend a great deal of time patiently explaining the matter to the architect, entirely neglect the consideration of the owner or agent of the building, and this very frequently proves to be

a costly oversight. It is a remarkable fact that men of large means and great property interests, no matter how much their time is employed in other matters, are always interested in this question of isolated plant versus central station service, and in the majority of cases are not only willing, but glad, to make personal investigation of the comparative merits of the two opposing lines of argument. The most progressive real estate agents in our large cities realize that this is a vital question for them to settle in the administration of the large business blocks which they handle, and a proper understanding of the merits of the central station proposition as applied to one particular building will often not only bring that individual building on to the central station service, but will be the means of securing a large amount of additional business controlled by the same agent.

Very often it is necessary not only to convince the owner or agent of the building of the advisability of omitting the isolated plant, but it may also be necessary to see the tenants of the building. An owner is sometimes forced by his tenant to install an isolated plant in order to make a lease of a building, owing to a mistaken idea of the tenant that there is great economy in operating a plant. In view of the above it will be seen that it is extremely important for central station managers to become thoroughly well-informed concerning all the transactions connected with the financing and leasing of a large building, in order that the benefits of central station service can be presented to the right parties and at the right time. Careful attention to these points and the intrusting of the discussion only to the most competent solicitors will gradually overcome the prejudices of the customer and eventually win for the central station the control of the situation.

Mr. C. A. Graves, of the Brooklyn Edison Company, contributes the following answer to the same query:

The average isolated plant superintendent or engineer does not know what it is costing him per kilowatt-hour to generate electricity. In the majority of cases he will either multiply the kilowatt capacity of the dynamo by about the number of hours run, or will multiply the high-average amperes by the voltage he is supposed to carry, to obtain the kilowatts, and then multiply the number of hours run to obtain the kilowatt-hours generated. It is human nature for the engineer to make the readings as high as possible.

To avoid this personal equation it is desirable to connect one or more watt-hour meters on the plant, checking up the coal and water records weekly. If steam is used for other purposes, two or three test runs of the engine should be made to determine the water rate, or the condensed water from the other apparatus be measured. Having the true cost per kilowatt-hour, the agent can show the advantage of central station service.

Mr. Ralph R. Laxton advises that if the service is good and production on a basis enabling competition in price, to take advantage of the growing demand for economy in building space, elimination of smoke, dirt and noise nuisances, and watch for depreciation and hidden leaks in isolated plants. At least prevent the duplication of many isolated installations now overloaded or worn out, and also use them as object lessons to prevent new installations of the same class.

"Intelligent work by solicitors," the Birmingham Railway, Light & Power Company answers briefly.

Gasoline-Electric Omnibuses in Paris.

Two types of electric omnibuses without storage batteries are now being used in Paris. One of these is the Krieger omnibus in which a 24-hp gasoline engine is direct-connected to a generator, the excitation of which is obtained by means of differential windings which serve to lower the voltage automatically when there is a great demand for current, while maintaining the engine speed and power output constant over a large range of speed of the vehicle. The motors, of which there are two, are geared to the back wheels and are compound wound. The second type of omnibus is the De Dion, which is somewhat similar, but employs a 30-hp gasoline engine running at 1,400 r.p.m. direct-connected to a compound wound generator which delivers constant voltage. Only one motor is employed, and this has two commutators which are placed in series or parallel by the controller.

The Burning of Cheap Fuels.--I.

NOTWITHSTANDING all that has been published on the economical production of steam from coal, more thought and energy are still being devoted to the building of steam engines of increased efficiencies, than to the problem of how best to burn coal under a boiler in order to render all the heat units in the fuel available for use. There are many causes which contribute to this state of affairs, and while improved engines are to be desired, improved boilers and furnaces are more so. It is not generally appreciated that there are greater possibilities of economy in the boiler room than in the engine room; or, in other words, that the cheap production of steam is very much more important than its economic use. Most important of all, however, is the obtaining of all the heat possible out of a dollar's worth of coal, and it is with this problem that the present article deals.

The more extended use of electrical energy depends upon its cheaper production; and this in turn depends upon the cheaper production of steam, so that anything which is conducive to the cheaper production of steam is vitally important to every central station manager. With present apparatus cheaper production presupposes cheaper fuel, and in what follows practical methods of burning the cheaper grades of fuel are given. The economy of using cheap fuel should, however, receive attention first; and for purposes of comparison figures from one of the most efficient plants in existence to-day, and therefore typical of the present state of the art, are given. In this plant 67 per cent of the heat from the coal fired under the boilers is transferred to the water in changing it into steam, the remaining 33 per cent representing the losses in the stack, ashes, boiler radiation and leakage. These losses could possibly be reduced; but the cost of the appliances might offset the gain made possible by their use. If now, the number of heat units from a dollar's worth of coal can be increased, the cost of this 67 per cent of available heat would be decreased and the losses in dollars and cents due to radiation, ash and chimney would also be lessened.

In the plant under consideration reciprocating engines of 7,500-hp showing a mechanical efficiency of 93.65 per cent are used, and the steam consumption at maximum economy is approximately 17 pounds per kilowatt-hour, which is equivalent to 20,349 b.t.u. per kilowatt-hour. Since one kilowatt-hour is equal to 3,412 b.t.u., the actual efficiency of the steam engine and electric generator is 16.7 per cent. The generator efficiency is approximately 98 per cent, so that the net engine thermodynamic efficiency is 17 per cent. Average figures for small plants would show that with a compound engine 20 to 30 pounds of steam are required per horse-power-hour; 30 to 50 with simple engines; 100 to 200 for simple pumps, and about 60 to 100 with compound pumps. As a horse-power is equivalent to 2,545 heat units per hour and it requires, say 1,000 heat units to produce one pound of steam at a pressure of 80 to 125 pounds under usual working conditions, the figures show that with a compound engine of about 400-hp only 10 per cent of the energy in the steam is used and about 1½ per cent of the energy in the steam is used in a simple pump. If all the heat units in the coal be considered, the compound engine would utilize only 7 per cent of the heat units and the simple pump one per cent. From the above figures it is evident that even with the best plant in use to-day only 10.3 per cent of the 14,150 b.t.u. in the coal is delivered to the bus-bar. It requires no great stretch of imagination therefore to see that doubling the efficiency of the steam pump, for instance, would still leave this machine wasting 98 per cent of the heat units available; whereas if the efficiency of a dollar's worth of coal be doubled the losses are reduced to 50 per cent. Moreover, increasing the efficiency of an engine means that only while the engine is in operation is a saving effected; all of the exhaust steam being used in the feed-water heater. On the other hand increasing the efficiency of a dollar's worth of fuel means a direct saving all the time. Central station men should therefore look to the boiler room, and not to the engine room, for true economy.

In the present article the burning of anthracite coals will be taken up, and of these only the buckwheats will be considered.

There are three sizes of buckwheat coal in the market, known as No. 1, No. 2, and No. 3. These are sometimes called buckwheat (No. 1), rice (No. 2), barley (No. 3), and between No. 2 and No 3 is a size called birdseye. The size of coal larger than No. 1 is pea coal. The heating values of these buckwheats is not so high as that of the larger coals owing to the presence of slate and other impurities; yet it is possible to obtain a No. 3 buckwheat higher in calorific value than a No. 1 buckwheat.

The thermal value of the coal used is of prime importance, since it affects the cost efficiency of the entire plant. The price of coal, of course, varies with the locality. The cost of the various small coals at tidewater New York is as follows:

No. 3 buckwheat	$1.40 per ton.
No. 2 buckwheat	1.80 " "
No. 1 buckwheat	2.35 " "
Pea coal	3.00 " "

To this is added 15 cents per ton for lighterage around New York Bay and 20 cents per ton when brought by boat from Perth Amboy, N. J. The price of coal delivered in New York City buildings ranges as follows:

Pea coal	$3.75 per ton.
No. 1 buckwheat	3.25 " "
No. 2 buckwheat	2.75 " "
No. 3 buckwheat	2.25 " "

The calorific value of the different sizes of anthracite ranges on the average from 12,000 to 10,000 B.t.u. per pound. From a number of tests made the relative evaporations by small anthracite coals were determined as follows:

Fuel.	Pounds of water per pound of coal from and at 212°	Pound of water per pound of combustible from and at 212°
Buckwheat	8.77	11.07
Rice (No. 2 buckwheat)	9.05	11.18
Barley (No. 3 buckwheat)	8.39	10.89

Starting with a boiler capable of converting 70 per cent of the heat in the coal into steam at a pressure of say 100 pounds, No. 1 buckwheat would evaporate under every-day conditions approximately 7½ pounds of water and No. 3 buckwheat about 7 pounds. In other words, the efficiency of No. 3 buckwheat is only 7 per cent less than that of No. 1 so far as steam-making qualities are concerned, while the difference in price between these fuels at tidewater New York is 40 per cent. Considered on a dollar and cents basis, the number of heat units per dollar in the small anthracites are approximately as follows:

Pea coal	6,500,000 heat units.
No. 1 buckwheat	7,000,000 " "
No. 2 buckwheat	8,300,000 " "
No. 3 buckwheat	9,000,000 " "

To burn the smaller sizes, however, some form of forced draft must be employed or else larger grate surface with high chimney. This would mean that from 2 to 5 per cent of the steam generated would be utilized to furnish the draft.

From the foregoing there can be no question but what the use of the smaller anthracites tends to economy in steam production, and this is the fuel used in and around New York City in most of the large power stations and buildings. The practical methods of burning the coal in order to obtain all the heat possible out of it naturally follows in importance.

Although it is possible to burn the fuel without a blast provided the grate surface is sufficient and the chimney is very high, best results are obtained by the use of a blast. Some skill is required in firing No. 2 and 3 buckwheat. The furnace should be fired light and often and the bed should be perfectly level so that the blast will blow through uniformly. The flues should be throttled by dampers so as to approach a balanced pressure in the combustion chamber. This necessitates the pushing of the gases through the throttled flue by the undergrate blast, causing them to reverbrate and intermingle with each other a great many times in the combustion chamber, and thereby affording greater opportunity for the oxygen to combine with the carbon particles. A high temperature in the furnace is also essential, in fact next to the blast it is the chief essential in the burning of this cheap fuel. Boilers with brick arches immediately over the grate are better adapted for the burning of the very small anthracites than boilers without, since in the latter case the gases are thrown directly against water-tubes or water walls which have not a temperature much higher than the water and steam in the boiler, and this is oftentimes lower than the temperature of combusion. The latest practice therefore is to furnish the boiler with arches over the grate either inside the boiler or in extended furnaces outside the boiler commonly called "Dutch" ovens.

A properly constructed steam blower furnishes a better quality of blast for burning small anthracite than that furnished by a fan alone, as a certain percentage of steam is required in the blast to keep the clinker soft and porous so that the blast will pass through even the clinker and burn the fuel on top. With a dry fan blast on the other hand the silicon in the coal, or the clinker forming material, becomes an impervious mass on the grate and the blast forming channels through the fire bed around the edge of the clinkers, the fuel on top is not supplied with the necessary oxygen. It therefore burns very slowly, while around the edges where the blast passes through rapidly the bed burns out very quickly and when the bed reaches a certain thickness the fire has to be cleaned and a large amount of partially burned coal on top of the clinkers is of necessity cleaned out with the other portion of the fuel bed, producing a serious loss in this direction. Too large an amount of steam, however, is detrimental instead of beneficial, and in selecting a steam blower one should be obtained that will furnish a large

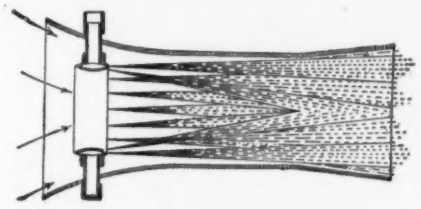


FIG. I.—ARGAND STEAM BLOWER.

amount of air with a small amount of steam. A type of blower very commonly used for this work is shown in Fig. 1. This produces a pressure in the ashpit by the expansion of steam emitted from small orifices, the difference in steam pressure between the inlet and outlet of the orifice being about 50 pounds. The rush of steam produces a powerful suction through the space surrounding the openings and causes the air to be drawn into the ash pit and discharged under pressure though the grate openings. A fan draft supplemented by a little exhaust steam is however more economical in operation than the steam jet.

The type of grate used in burning small anthracites is important and the number of grates devised for this purpose is very large. No one set of conditions, however, is applicable to all sorts of fuel, so that with different fuels, different grates, different air pressures, etc., have to be provided. In burning the small anthracites some form of shaking grate is used so that the fire may be cleaned quickly without loss of temperature in the furnace proper. While No. 1 buckwheat may be burned advantageously on one of two types of mechanical stoker, the No. 2 and No. 3 buckwheat is burned with fully as great a degree of economy on properly constructed shaking grates fired by hand.

Contrary to old-time practice the trend of modern practice is toward a much larger grate area, especially with the type of coal under discussion. The ratio of grate to heating surface for the smaller sizes of anthracite should not be much over one to thirty. Any type of boiler arranged with a suitable arch may be used in burning the cheap anthracites. Where no arch is present the return tubular boiler possesses a slight advantage over the water-tube boiler because the shell of the boiler acts as a baffle to throw back the heat onto the fire surface proper. With the shaking grate any fireman will obtain results with rice and barley coal, which though they contain more ash and therefore require more frequent cleaning, are nevertheless robbed of the ash easily by this means. With the flat grates the fire must be puddled to get rid of the ash or else it is mowed down with the hoe. Deep ash pits should be provided, since with frequent cleaning the accumulation of ashes in the pit increases the liability of the burning out of the bars from underneath. This is true of any boiler setting; but since the small anthracite coals have more ash in them than the larger sizes, the importance of deep ash pits in connection with this fuel should not be overlooked.

Notes on the Burning of Small Anthracite Coal.

By E. H. Peabody.

IT is a well known fact that the larger sizes of anthracite such as broken, egg, stove and even chestnut, can be handled in the boiler furnace with ease, giving excellent results, not only in economic evaporation per pound of fuel, but in amount of horse-power developed as well. No great skill in firing is required, the main requisite being to get the coal into the furnace in a fairly even bed. The relatively small amount of ash in these coals permits of operating the furnaces for long periods without cleaning fires, and the cleaning is facilitated by the use of grates with wide air openings, allowing a considerable portion of the refuse to drop through the grate bars into the ash pit. Further, the draft necessary to burn the larger size coal is not excessive so that ordinary chimneys answer all requirements.

But the greatly reduced prices of the very small sizes of anthracite now common in the market, are an ever present inducement to the owner of a steam plant to change his fuel and burn No. 2 or No. 3 buckwheat. If he can do this and at the same time maintain the necessary output of steam from his boilers this will doubtless prove to be a money-saving proposition at the prevailing prices of the large and small sizes of anthracite coal.

In making the change, however, the essential problem which confronts his engineer is, how to keep up steam with the low grade fuel. A few hours shut down or appreciable lack of capacity may much more than offset any saving in cost of fuel effected by the use of the cheaper grade. The matter of maintaining the standard of efficiency is important, but nevertheless is secondary to the question of capacity.

What special features of the problem therefore must be considered and adequately provided for in order to insure plenty of steam with the new fuel? In the first place, grate bars with narrow air spaces must be used. "Pin-hole" grates or bars perforated with round holes about ⅜ in. in diameter have been very successfully applied for use with small anthracite. These bars, however, have a low percentage of air space—usually less than ten per cent, and hence are invariably used with forced draft. A grate bar of the herringbone type having air spaces ¼ ins. in width is well adapted for burning buckwheat coal and is commonly used both with natural draft and forced blast. This bar generally gives a percentage of air space exceeding thirty per cent, which is entirely adequate. It is supposed by many that grate bars with air spaces aggregating forty-five to fifty per cent are necessary in order to give a sufficient air supply. These people do not stop to think about the resistance of the coal bed itself and their counsel often leads to great waste of fuel in the ash pit, due to loss of coal which has sifted through the bars.

The second point to be considered is how much of the buckwheat coal must be burned to produce the same amount of steam generated by the large size coal. This matter involves both the questions of efficiency and the relative heat values of the two coals. More skill is required in firing the small size fuel: it must be spread lightly and evenly over the grate at frequent intervals, and the cleanings come oftener and require more time and labor; but the writer believes that a competent and careful fireman will obtain practically the same efficiency with the small as with the large size coal. As to heat value, while not strictly true for all anthracites, it is usually very nearly the case, that the heat value per pound of combustible (that is the dry coal after deducting the refuse) is the same for all sizes. Assuming, then, that the same efficiency will be obtained, it is only necessary to determine the relative amounts of ash in the two coals in order to calculate how much more of the small size will be required. There is no royal road to this information; the character of the coal and the care with which it is mined and prepared for market greatly influence the ash and refuse present in the coal and each particular lot provides a law unto itself.

Moisture in the large sizes is an inconsiderable item, but in the small size coal, may represent a possible eight or ten per cent (usually much less) and it is important when getting prices on coal to ascertain what proportion of it is water; at the same rate per ton. The buyer of anthracite coal, however, has always a ready means of testing the quality of his fuel, he needs only to determine the ash and moisture—the rest of it is combustible matter of very uniform quality.

Ordinarily, it may be considered that buckwheat coal contains twice as much ash as egg—about in the proportion of 7 per cent or 8 per cent to 14 per cent or 16 per cent. No definite limits, however, can be taken as a very safe guide. The writer has tested No. 3 buckwheat containing but little more than 10 per cent of ash, while on the other hand he has found the ash in No. 2 buckwheat as high as 20 per cent. Each separate lot should have a special test.

The following example will serve as a basis for comparison of egg and buckwheat. Assuming the heat value per pound of combustible as 14,500 b.t.u. and 8 per cent ash for egg and 16 per cent ash for buckwheat, we should have as the heat value per pound of dry coal 13,340 b.t.u. for the egg and 12,180 for the buckwheat. Assuming further that 70 per cent efficiency of boiler and furnace combined will be obtained in daily practice, the result will be an evaporation of 9.67 lbs. of water from and at 212° F. per pound of dry egg and a corresponding evaporation of 8.82 lbs. per pound of dry buckwheat. It will therefore require 3.57 lbs. of egg coal to develop one boiler horse power and 3.91 lbs. of buckwheat, or nearly ten per cent more buckwheat, for the same amount of steam. The calculation is based on dry coal and any difference in moisture would, of course, have to be allowed for.

Seventy per cent efficiency may easily be exceeded by a good fireman, handling a well designed boiler and furnace; but while a great deal might be written concerning boiler efficiency, it will be sufficient for the present purposes to consider that 70 per cent is obtained using both egg and buckwheat.

Having determined approximately the amount of buckwheat coal it will be necessary to burn under the boiler to give the necessary power, the next step is to make provisions for burning it. This can be done by increasing the draft or by increasing the grate surface, or both. The small particles of buckwheat coal present a much more dense and compact bed of fuel than do the larger sizes and in order to force the air for combustion through this bed a greater pressure or suction is required. If natural draft is to be used therefore, the height of chimney becomes a very important consideration. It would be well for the engineer to measure his draft at the boiler damper and find what is the maximum available.

It is not possible to approximate more than the actual draft required for burning buckwheat coal. It varies not only with the size, but with the style of firing and the kind and quantity of ash. Roughly, the following table will indicate the draft in inches of water at the boiler damper necessary for various rates of combustion:

	Draft.
10 lbs. per square foot of grate per hour.....	0.30 in.
15 " " " " " " " "	0.45 "
20 " " " " " " " "	0.70 "
25 " " " " " " " "	1.00 "

Suppose that previous calculations have shown that 700 lbs. of buckwheat coal must be burned hourly under the boiler to give the necessary steam, and suppose that the grate surface equals 30 square feet in area. Suppose also that the available draft equals six-tenths of an inch of water. The engineer can either increase the grate surface to 40 sq. ft. and burn the coal with natural draft at the rate of 17½ lbs. per square foot per hour or he can increase the draft to nine-tenths by building a taller chimney or by putting in forced blast, and burn the coal on the present grate at the rate of 23⅓ lbs. per square foot of grate per hour.

The nature of buckwheat anthracite is such that it can be used with very long grates,—furnaces 12 ft. in depth being not uncommon with very large boilers. The coal can readily be spread over this length of grate, and as the fire does not have to be "worked" no unusual labor is required except at the time of cleaning fires. For this purpose dumping grates are used, a long hoe being employed to pull the good coal away from the section to be dumped.

Dumping and shaking grates are nearly always useful in handling low grade anthracite coal; the dumping property being perhaps even of greater value than the shaking. With ordinary lengths of grate, however, up to 7 or 8 ft., if the fireman is required to clean out his own ashes, he is quite likely to prefer cleaning fires in the ordinary way by pulling the refuse out through the fire door into a wheelbarrow, thus entirely ignoring the dumping grate. The real value of the dumping and shaking grate consists of the facility it offers for making a quick cleaning, thus aiding in keeping up the steam pressure and saving heat by not allowing the furnace to become cooled off.

In the modern office building of the "sky-scraper" type, with chimneys 200 ft. high and over, low grade anthracite coal may readily be burned under natural draft and in sufficient quantity per square foot of grate per hour to give a good margin above rating from the boilers using ordinary ratios of heating surface to grate. In cases, however, where the chimney is 100 ft. or less, it is quite usual to use forced blast in the ash pit; sometimes induced mechanical draft being employed instead. The use of blowers has the advantage not only that tall chimneys are not needed, but that the draft is then entirely independent of weather conditions. The cost of operation and upkeep, on the contrary, are factors in favor of natural draft.

Some small anthracites have a tendency to form very bad clinker, in which case a forced draft produced by steam jets has been proved to be very efficacious. The action of the steam in passing through the fuel bed keeps the clinker soft and porous, resulting in excellent capacity and very quick, easy cleanings. This form of blast is practically indispensible with some fuels.

Feed-water Purification.

By R. T. Strohm.

The production of steam from water, as carried on in the ordinary steam boiler is nothing more or less than the first step in a process of distillation. If the steam produced is quite dry and free from moisture of any kind as it leaves the boiler it will reduce to pure water when condensed, and this condensation if re-evaporated will leave no visible residue.

Now, if absolutely pure water were furnished to a steam boiler the evaporation of that water could be carried on for an indefinite period without the collection of extraneous matter inside the boiler. This would be the ideal condition of operation. However, it is never realized in practice, for the reason that absolutely pure feed-water is altogether too expensive to be obtained, and also because the water is far from being pure in most cases.

Boiler feed-water may be drawn from streams, from lakes, or from wells. In any case, the water has either flowed along the surfaces of the earth or has filtered through various depths of the surface strata. Pure water possesses the property of absorbing the materials with which it comes in contact. Consequently, as the rain passes over the ground or sinks into the earth it dissolves many substances. These vary in amount according to their solubility. Besides these, water may pick up and hold in suspension matter that is not soluble, as, for example, sand, clay and organic substances.

Water of this kind, therefore, when fed to a boiler and evaporated, leaves behind it all of the impurities which it has absorbed or entrained, and the result is that these impurities accumulate and hinder the proper action of the boiler.

The hindrance to proper working of the boiler may manifest itself in several ways. If the impurities are such that they bake into a hard crust on the shell, the passage of heat from the furnace to the water will be retarded and the evaporative capacity of the boiler will be lowered. If the impurities are light, so that they float on the surface of the water they are liable to cause foaming, which is undesirable. If the impurities consist of acids, the plates, tubes and fittings will be eaten away, rendering them weak and unsafe. If the impurities collect in heavy deposits, as sludge, the transmission of heat will be rendered less rapid and there will be great danger of overheating the plates or tubes.

In view of these facts, then, it becomes extremely desirable to remove from boiler feed-water as much of its foreign matter as can economically be separated from it, and to change into harmless forms such impurities as cannot be removed directly. Such treatment of feed-water is commonly termed feed-water purification, and because of its importance it has grown to be an industry of no mean proportions. Briefly, there are three reasons for purifying feed-water:

(1) To prevent loss of fuel, by having clean surface and rapid heat transmission.

(2) To avoid, as far as possible, the danger of boiler accidents.

(3) To reduce the cost of repairs.

There are four distinct methods of purification which may be used separately or in combination. They are:

(1) By settling, or sedimentation.

(2) By straining, or filtration.

(3) By heating, or thermal action.

(4) By chemical action, such as precipitation or neutralization.

The sedimentation process is of very limited application. All that it can do is to remove silt or sand which has been entrained with the water, and in order to do this effectively the water

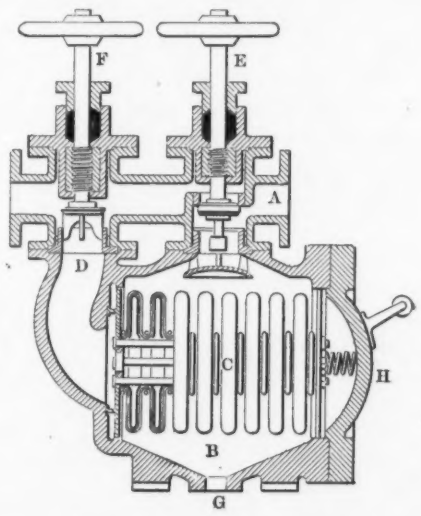


FIG. 1.—FEED-WATER FILTER.

must be run into settling tanks and allowed to remain motionless until the mud sinks to the bottom by its own weight. Obviously, if a power station were of considerable importance, the size of tanks required to permit the proper settling of impurities would be so large as to prohibit the use of this method. For the settling process is slow, and cannot be hastened.

If mud, sand and organic matter are contained in the feed-water and must be removed rapidly so as to permit continuous feeding of large quantities of water to the boilers, filtration should be adopted. There are a number of ways in which a filter may be constructed. For example, a wooden tank with a perforated false bottom may be used. On the false bottom are placed charcoal, coke, gravel, pebbles or hay, or combinations of these materials. The water, flowing in at the top, passes downward through the filtering materials, being thus purified, and is then withdrawn by pump from a chamber beneath the false bottom and fed to the boilers.

The weight of the water is the force which causes the action of the coke and gravel filters, and the rate of filtration is therefore liable to be slow. If the water is put through a filter under pressure a more rapid action may be secured. Fig. 1 shows a cloth filter in which the water is under pressure during filtration. The feed-water is admitted at *A*, from the feed pump, and flows downward into the filtering chamber, *B*, which contains the filter, *C*. This filter is composed of a light bronze framework over which is drawn a bag of the cloth known as Turkish toweling. This bag is then drawn down between the several sections of the framework and tied with cords, as shown, thus exposing a large area of filtering surface. The sections are held together by four long bolts.

The inside of the filter, *C*, forms a hollow chamber communicating with the outlet pipe, *D*, which leads to the boiler. Therefore, the water must pass from the filtering chamber, *B*, through the filter cloth, *C*, and thence out at *D*, leaving all mud, oil or other foreign matter on the filter. This eventually hinders the action of the filter. A pressure gauge is attached to the filter chamber and another communicates with the outlet side of the filter. When the difference between the readings of the two gauges amounts to about 3 pounds, the filter requires cleaning. This may be done by closing the valves, *E* and *F*, and opening the drain, *G*. If the valve, *E*, is then opened slightly, the current of water from *A* through the chamber, *B*, to the drain, *G*, will loosen much of the accumulated sludge from the filter. If the valve, *E*, is then closed, and *F* opened, the water will flow through the cloth in a reverse direction, and out at *G*, carrying the dirt with it. If this method fails to clean the apparatus properly, the cover plate, *H*, must be removed and a new filter cloth put in. While this is being done, the valves, *E* and *F*, may be closed, and the water fed directly to the boiler. It would be better, however, to have more than one filter, so that each could be shut down for cleaning, at intervals, without interfering wholly with the filtering.

In many plants that are run condensing, the condensed steam is led to a hot well and from there returned to the boiler as feed-water. In its passage through the engine, the steam picks up a considerable amount of oil which it carries along with it. In spite of oil separators some of this oil is liable to find its way to the hot well, and thus to the feed pump. If, however, a filter of the type shown in Fig. 1 is used, the entrained oil may be completely removed.

The most troublesome of the scale-forming impurities found in ordinary boiler feed-water are the carbonates and sulphates of lime and magnesia. These, however, may be treated by the heating process, so that the feed-water may pass to the boiler fairly well purified. For, the impurities mentioned are held in solution in the cold water. But if the water is heated it can no longer retain the impurities, and they appear in solid form, this being known as precipitation.

The carbonates are held in solution because the water contains carbonic acid. If the water is heated to the boiling-point, or above, the carbonic acid is broken up and driven off as a gas, and the result is that the carbonates are precipitated, since the agent that has held them in solution in the water is destroyed. Since 212° F. is the temperature of steam at atmospheric pressure, it is evident that the exhaust steam from engines can be used to furnish the heat for precipitating the carbonates.

If sulphates are present, however, the heating must be carried on at a much higher temperature, to secure purification. The sulphates are soluble in water up to about 290° F., so that, to precipitate them, it is necessary to heat the water to approximately 300° F. This means that live steam of a pressure of 45 lbs. or over must be used.

The carbonates, of themselves, do not really form a scale, but rather a fluffy deposit which alone may easily be washed and scraped loose. Unfortunately, however, other impurities, such as oil, organic matter and mud are liable to get into the boiler, and the mixing of the carbonates with these materials results in the formation of a heavy sludge which will settle upon the tubes and sheets and soon harden under the action of the heat from the fire. The sulphates, on the other hand, are dreaded even by themselves, since they form hard, clinging scale which is most difficult to remove.

The fourth method of purification, that by the use of chemicals, is very largely used at the present time. It consists of adding certain chemicals to the feed-water so as to change the nature of the impurities from a harmful to a less harmful or harmless condition. This chemical purification may take place either before or after the water is fed to the boiler. The latter is the more common, for the reason that the boiler is thus used as the vessel in which the reactions may occur. When purification is carried on before feeding the water to the boiler, tanks must be built for the special purpose of treating the water.

The way in which impure water is rendered suitable for boiler feed-water may best be illustrated by examples. As already stated, the sulphate of lime forms a very hard scale. If, however, carbonate of soda is introduced into the water, the sulphase of lime is changed to carbonate of lime, which settles in a fluffy form, while the carbonate of soda becomes sulphate of soda, which remains dissolved in the water and has no harmful action upon the boiler.

If the water contains both sulphate of lime and carbonate of lime, caustic soda may be used to advantage. The first action that takes place is the precipitation of the carbonate of lime, with the formation of carbonate of soda, and the carbonate of soda acts upon the sulphate of lime, breaking it up as already explained. In case the carbonates and sulphates of magnesia are present in the feed-water, the same general methods are followed.

It must be distinctly borne in mind, however, that chemical purification does not destroy the impurities. It simply converts them into other forms which will not act injuriously on the boiler. Consequently, if the chemical action takes place after the water is fed to the boiler, the precipitated materials will collect on the sheets and tubes and must be washed out at regular intervals.

There is yet another class of impurities which may be found in boiler feed-water and which, when present, is the cause of serious trouble. The class referred to is corrosives, or those impurities which attack the metal parts of the boiler and eat them away. Such action is due to the presence of free acids in the feed-water, the common ones being sulphuric and tannic acids, though others may occur. For example, if water containing magnesium chloride is introduced into a boiler and heated, muriatic acid is liberated, and this free acid has a very rapid corrosive effect on the boiler. To counteract corrosion, alkalis should be added, which will neutralize the acids present.

A New Type of Steam Condenser.

The Electrical Works, Wallasey, Liverpool, are equipped with steam condensers possessing novel features and whose principle of operation is as follows: The exhaust steam is led into one end of the condenser, which consists of a large, cylindrical, wrought-iron chamber, divided inside by baffle plates into three separate portions. The steam, on entering the first chamber, which is of large volume, has its velocity impeded, and consequently the oil, grease and other impurities fall to the bottom of the chamber and are led away to a small grease pump or settling tank. The steam then passes upwards and circulates round the next chamber. Into this chamber the feed-water is led by a separate pipe (the water meets the steam, and is raised up to the same temperature, while impurities present fall to the bottom of the chamber), while from this chamber to the feed pumps is a connecting pipe, which ensures a very high temperature of the feed water. After being purified, the steam passes to another chamber, where it meets a current of water entering in the opposite direction, and is condensed. A wing valve in the injection pipe is regulated by a float and levers, so that the water level in the condenser is kept constant. The whole of the water is taken away by a water pump from the bottom of the condenser chamber, while a dry-air pump takes away the air from the top.

The water pumps discharge into cooling towers, and on being cooled the water is drawn up again by suction due to the vacuum into the condenser, which process constantly recurs. By this means the water required for condensation is reduced to a minimum. A vacuum of 27.5 in. is steadily maintained under a variable load of traction and lighting. Under these conditions the feed water is kept at a temperature of 100° F., very free from grease and reduced from 25 degrees to 12 degrees of hardness. The results show a distinct advance over condensers of the ordinary jet or surface type, the more so, since to all intents and purposes it comprises a grease separator and a feed-water heater, and takes up less floor space than is required by other types.

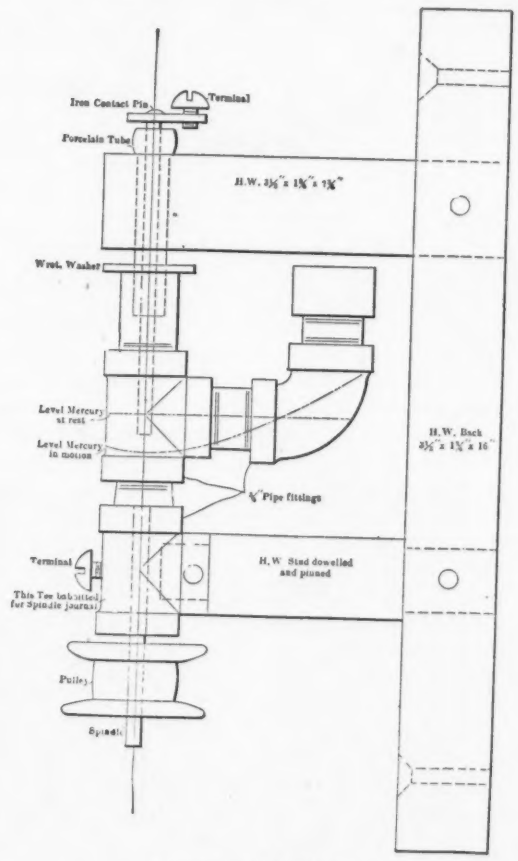
The condenser is particularly suitable for use in connection with steam turbines.

LETTERS ON PRACTICAL SUBJECTS.

A SAFETY MOTOR STOP.

A large chemical manufacturing company in the Northwest operates a number of well pumping plants by electric power. Each pumping station consists of a "derrick" over a deep-driven well, and a "drill house" containing the pumping machinery. The whole outfit is very similar to what is used in the oil regions, the working barrel of the pump being near the bottom of the well. The sucker rods are hung from one end of a large wooden walking beam, the other end of which is driven by a pitman and crank. The crank shaft is belted to a counter shaft, which is in turn belted to an electric motor. The weight of the iron sucker rods is counter-balanced by several thousand pounds of cast-iron weights, which are hung on the crank end of the walking beam.

These wells are operated at distant outlying points and are inspected only occasionally by a watchman. Should a well pole break, the walking beam is thereby unbalanced, and there is risk of serious belt slippage with attending fire hazard. It



SAFETY MOTOR STOP.

became necessary, therefore, to install a device which would shut down the motor in the event of a broken pole causing a belt to slip.

The drawing, herewith, shows a very simple device which has been applied with success. It consists primarily of a cistern made of iron pipe fittings and nipples which revolves upon a vertical axis driven by a quarter turn belt from the crank shaft. The cistern contains mercury which, when at rest, makes contact with an iron contact pin reaching down into the cistern. When the cistern is revolved the mercury flows to the outer circumference and breaks connection with the contact pin. The two terminals are connected in circuit with the terminals of the winding of the no-voltage release magnet on the face of the starting rheostat, so that when contact is made between the contact rod and the mercury, this coil is short circuited and the starting lever thereby released and permitted to return to its initial position cutting out the motor. It will be seen that, if for any cause the crank shaft comes to rest or lags below a certain critical speed the device will operate to stop the motor, thus effectually preventing belt slippage or damage in case of the unbalancing of the walking beam.

Midland, Mich. T. GRISWOLD, JR.

LAYING UP STEAM ENGINES.

Some time ago a certain plant was shut down for an indefinite time as the business had been discontinued. The engine was allowed to stand just as it had been stopped for several weeks. At a convenient time a man was sent to take care of it. He put cylinder oil on all bright work, but did not open the cylinder nor do anything with the valves.

This is not right, and anybody who wishes to preserve an engine for future use, should do the work of laying it up much more carefully. Cylinder oil will keep bright work from rusting for a few months, but should not be depended on for a long period. White lead will answer the purpose much better, as it will not seek the lowest part of whatever it is put on, like cylinder oil, but will stay where it is put. It should be made thicker than for ordinary painting purposes.

The piston of an engine that is not to be used for some time should be taken apart, all pieces thoroughly cleaned, dried, and covered with something that will prevent them from corroding. The necessity for this is not always understood by engineers and steam users, but it is important because water is always left in the cylinder of an engine when it is shut down, and if not removed it causes corrosion.

In this case the piston was fitted with an excellent set of two packing rings, both made in sections, but if left in that condition for a year they would be unfit for further use and a new set would have to be made.

The valves of an engine are almost sure to hold some of the water resulting from the condensation of steam, therefore they should be carefully removed, and all parts painted with white lead. It can be removed whenever it is desired to use the engine again, as it does not adhere to iron like it does to wood. Care should also be taken to take out every piece of fibrous packing, for if any is left in contact with metal it will make a bad spot, and will probably ruin that part of the machine.

Where there are several parts that are nearly alike, as for illustration the several parts of the valve gear of a Corliss engine, they should be marked with a sharp prick punch, so that whoever puts them together may know just where they belong. Where several nuts are taken from cylinder studs or other places, the threads should be covered with graphite mixed with cylinder oil, and each nut put back where it belongs, for if left loose they will get mixed and these nuts do not always fit the studs indiscriminately, therefore it is safer to keep them in proper order.

Erie, Pa. CHAS. JACOBS.

ECONOMY DUE TO SLIGHT BOILER REPAIRS.

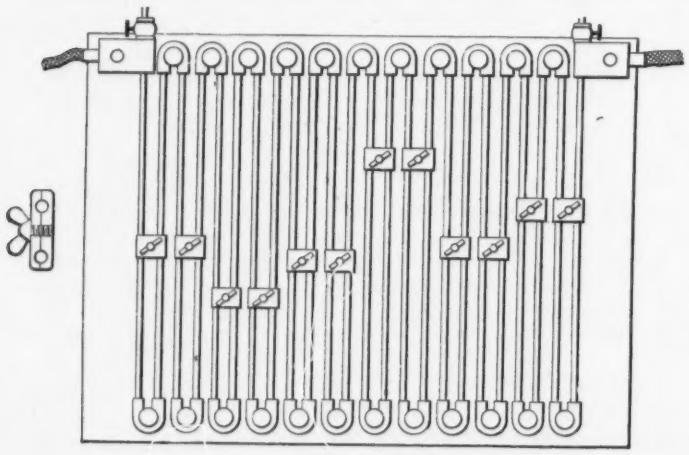
An object lesson which brings out more forcibly than is possible in any other way the absolute necessity of paying particular attention to small details in boiler management if economy is desired, is furnished in the following incident: In an isolated plant supplying power and light to a factory is a horizontal return tubular boiler. After this had been in service a number of years several small cracks began to appear in the brick setting due to the settling of the foundation, and although these were not large they were noticeable. The engineer made a number of requests for the necessary supplies to fill up these cracks and to point up the entire setting, but the manager could not see the necessity for this and the requests were always politely refused. Finally however, the boiler began to chew up coal and an expert was called in who, seeing the cracks, immediately recommended to the manager that all such hindrances to the draft of the furnace be removed; but the manager could not be convinced that a few cracks in the boiler setting would make more than a few cents worth of difference in the expense, at the most. Finally he was induced to try the remedy suggested on condition that if the fuel consumption was not reduced the expert would receive no compensation for his services; so a test was made of the coal

consumption of the boiler with the cracked setting. Arrangements were made to keep a careful record of the amount of coal burned under the boiler and also a record of the conditions under which the boiler was operating in order that these conditions might be duplicated or allowances made for any difference when the boiler was tested after the cracks had been filled and the setting pointed up. A test of one week's duration was made on the boiler and a record kept of the coal consumed and the temperature of the feed-water, etc. All conditions were kept as nearly constant as possible; the level of the water being kept at the middle gauge cock and the damper in the chimney being kept in one position throughout. Hourly readings were taken of the ammeter and the voltmeter to determine approximately the power being used by the engine. The boiler was then allowed to cool on the Sunday following the test, and the necessary repairs made to the boiler setting. A test was then made with a lighted candle to determine if all the cracks had been closed. Steam was then gotten up and a record run made, the same facts being recorded as in the case of the previous test. The load on the engine was almost the same during the test as was also the temperature of the feed water; but the amount ot coal burned during the test was over two tons less than that burned during the first test. This meant that while the cracks remained in the setting over six dollars a week were being uselessly expended, or $300 per year, a pretty respectable sum. The manager, unable to get around the facts, was convinced of the utility of keeping the boiler and setting in repair, and the expert was paid for his services.

Chattanooga, Tenn. Lee Fitch.

SIMPLE FORM OF ADJUSTABLE RESISTANCE.

I note in reading over my letter published in the July 7 issue that the illustration does not fit the text which reads: "When all the bridge pieces are at the top end of the resistance the whole current passes direct to the apparatus through the heavy U-shaped couplings and the bridges, whereas when all the bridge pieces are at the bottom of the resistance, practically the entire



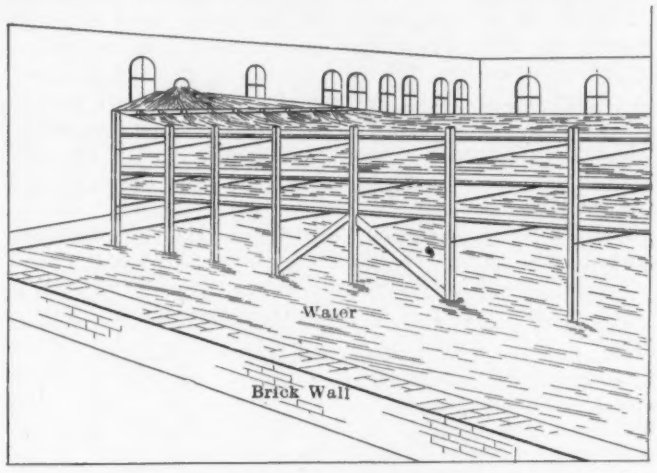
SIMPLE ADJUSTABLE RESISTANCE.

length of the tubing has to be traversed by the current." In preparing the illustration I did not think of this sentence and placed the bridge pieces at random and unfortunately across the wrong tubes. Inasmuch as the device is very useful I send herewith a corrected drawing so as to make the illustration fit the text. The device is so simple that the error would be apparent; but I note that a number of trade papers have republished a description of it without catching the error.

Brooklyn, N. Y. C. T. James.

NOVEL COOLING ARRANGEMENT FOR CONDENSER WATER.

In a large Western power house there are two large tandem-compound horizontal engines, the exhaust steam from which is handled by two jet condensers and independent air pumps. The station being inland, there was no opportunity for obtaining a sufficient supply of cold water for condensing purposes, and a cooling pond of sufficient area to handle the output of the station would be too expensive. Cooling towers would also require a considerable amount of power for the operation of their blowers, if of the forced draft type, and would be quite expensive, if of the natural draft type. For purposes of economy a cooling table was installed. This is virtually a small pond, the surface of which is multiplied by causing the water to circulate over a number of wooden platforms, slightly inclined so as to cause the water to move from end to end of each platform. The number of platforms over which the water was caused to flow was three, after which it dropped into a small pond beneath the platforms, the water being constrained to flow back and forth



COOLING ARRANGEMENT FOR CONDENSER WATER.

over the whole surface of the platforms in succession before falling into the pond, from which it was drawn by the condenser pump. Air is allowed to circulate freely between the platforms, which are exposed so that the wind blows through and constantly carries off the water which rises in the form of vapor. In this way the available space for evaporation over a pond occupying a given space is materially increased, making it possible to cool the condensing water of a large plant in a reasonable space without power consuming auxiliaries or such expensive draft producing towers as are necessary in a natural draft arrangement. At the plant in question the pond is 150 ft. by 60 ft. and excavated to a depth of 5 ft. A brick wall is carried up around the bank for a height of about 2 ft., thus giving a depth of 7 ft. to the basin. This is floored with concrete and the walls of the basin have sloping faces of concrete with a cement facing. The table is not as large as the pond, being about 130 ft. long by 30 ft. wide. Two-inch flooring is used, the joints being painted with lead. The outcoming hot water from the condensers discharges on a flaring incline and is distributed the full width of the table by distribution boards forming a sort of slotted dam. The table, of course, steams constantly when the plant is in operation; but the steam is not found to be an objection and is soon dissipated by the wind. With the usual load on the plant a vacuum ranging from 22 to 26 ins., depending on the weather, is obtained. In ordinary weather the temperature of the condenser discharge is about 115 to 120° and the water is returned at about 90°. The cylinder oil from the engines collects in the corners of the pond where it can be easily removed and filtered if desired. The evaporation from the pond is supplied by the addition of fresh feed water obtained from the town supply, the water finding its way to the pond through the jet condensers.

Chicago, Ill. Charles Bergen.

CHANGING THE FREQUENCY OF ALTERNATOR.

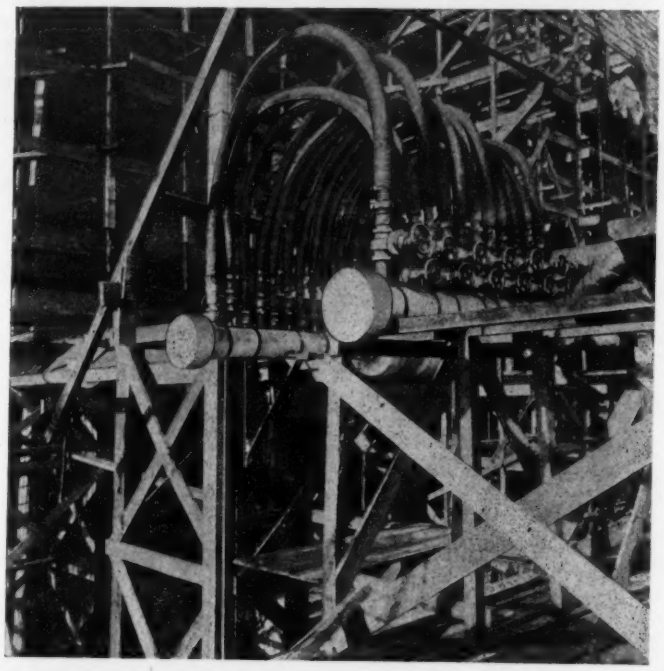
Referring to the editorial on this subject in the Electrical World of August 4, it may interest some of your readers to know that several years ago we changed the frequency of one of our alternating-current generators from 120 to 60 cycles. The alternator was a No. 2016 General Electric machine 14-120-1070. In making the change all that was done was to connect the two halves of the armature in series, whereas they had before been in parallel. The machine then gave 1,100 volts at 60 cycles when run at one-half its former speed. Its output

was, of course, reduced one-half by the reduction in speed. We also have some 220-volt direct-current generators which were formerly 500-volt machines operating at double their present speed.

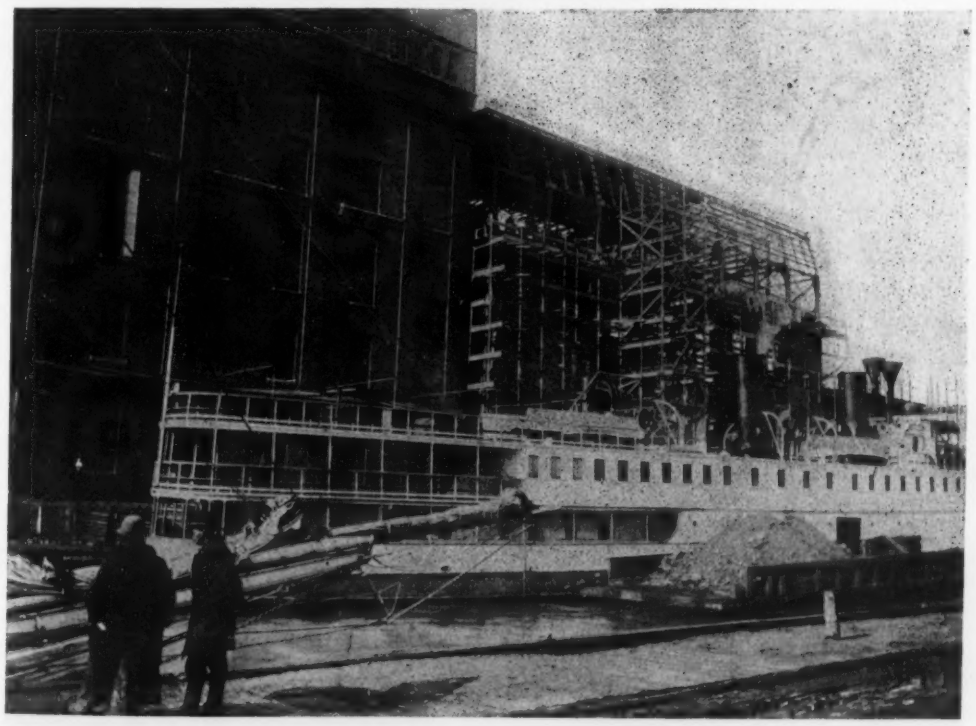
Galveston, Tex. J. R. Cox.

GETTING STEAM FOR AN OVERLOADED POWER STATION.

While the writer was in Baltimore recently he was told of an ingenious method of supplying steam to the Pratt Street power house of the United Railways and Electric Company. If mention has been made of this in the technical press, I have never seen it; and knowing that a short account will be interesting to your readers I send it herewith. It is probably known that during the great fire in Baltimore the Pratt Street station was damaged and together with the rapid rebuilding of the destroyed section the company came face to face with the prospect of an insufficient steam supply during the winter. New boilers were being installed, but it was found that the plant could not be gotten ready in time for the Christmas season when the demand was greatest. To augment the boiler capacity the company chartered the steamer *Lord Baltimore,* a passenger boat used during the summer in making regular trips between Baltimore and Philadelphia, and which at that time was not in commission, having been laid up for the winter. The steamer was moored alongside the dock at the power house and connections were made so that the steam generated in the boilers of the boat could be used in operating engines in the power house. The boat's boiler equipment consists of four marine water-tube boilers with an aggregate capacity of 1,000-hp, and on overloads 1,500 boiler horsepower could be obtained. The engines of the boat were disconpected from the boilers and a 10-in. tap was taken from the steam header in the boiler room of the power station and extended to the water's edge alongside the steamer. The end was supported by a trestle work and terminated in a 10-in. manifold. Supported on the top deck of the steamer was a second manifold, 8 ins. in diameter. The two manifolds were connected together by a series of flexible copper tubes so that the rise and fall of the steamer with the tide would not interfere with the continuity of the steam supply. The arrangement allowed a maximum range of 7 ft. The manifold on the steamer was connected by a single 8-in. header to the main steam drum of the boat's boilers. A 10-in. stop valve was placed inside the station boiler room in order to control the auxiliary steam supply from the boat and a non-return automatic valve was placed in the connection next the water so that if the steam pressure in the boat's boiler should drop below 200 pounds, there would be no possibility of bleeding the station boilers. This emergency connection worked well during the Christmas season and was utilized for some time after during peak loads.



FLEXIBLE COPPER TUBES BETWEEN BOAT AND PIER.



STEAMBOAT SUPPLYING STEAM TO PRATT STREET POWER HOUSE.

New York. CARTER MICHEL.

LOCATION OF BOILERS.

The letter in the August issue, by C. D. Audley, on "Location of Boilers," was certainly interesting. I can't understand why it is that boilers and engines are placed into such out-of-the-way places. The people who are responsible for their installation don't seem to use any common sense. Architects and consulting engineers evidently give little or no thought to these matters, as a few samples of jobs that I have worked on will show.

I was at one time in charge of a hydraulic elevator and heating outfit that was certainly a wonder. The boiler was a Climax, vertical, water-tube. It had a circular firebox, with the steam-dome running down through it; thus the grate represented the area existing between two cencentric circles. This boiler was set down in a pit in such a fashion that two of the fire doors couldn't be opened at all, and the other two could only be fired cornerwise. The coal had to be thrown around a corner, boomerang fashion.

The boiler wasn't half big enough for the work it had to do, and had to be driven real hard. The ashes had to be removed in a small nail keg, carried in my arms, like a child. There wasn't room enough between the boiler and the wall to pass an ash can through, in fact, it was hard for me, even, to pass through.

One day a water main in the street burst, thus shutting the feed-water off without notice. The water began to drop suddenly in the glass and I started to haul the fire, which was a very heavy one, I assure you. I couldn't get enough ashes in a hurry and had no water. I hauled as long as I could stand it,

threw some fine coal on to the mess on the floor, and then bolted up a ladder for a breath of fresh air, nearly overcome by heat, gases and smoke. I had to repeat this operation half a dozen time before I finally got all the fire out. I don't know where the water was, but I did the best that could be done under the circumstances.

The elevator machinery was located at the bottom of a little ditch, the top of which was loosely covered with old planks. Every time I moved one of the old ash cans much of the contents would fall down on to the machinery below. The whole plant was a botch and strongly reminded me of Dante's descriptions of the infernal regions.

In a cellar of a bank building a steam elevator engine was jammed up against a brick wall in such a fashion that it was exceedingly hard to get at for repairs and adjustment. It was a large cellar, too, and there was nothing else in it. Now, why in the world wasn't that elevator engine placed a little farther from the wall? Because, the architect who drew the plans, placed a small square, representing the engine, up close to a straight line, which stood for a brick wall, thus causing every engineer who ran that job for many years afterward, a needless amount of hard work, taking care of that engine.

The boiler in this place was a cast iron affair in sixteen sections, and carried 65 lbs. of steam. This should never have been allowed. When this was being installed the owners didn't want to go to the little expense of connecting up the blow-off to a tank and thence to the sewer, but wanted the engineer to draw the water off, a pailful at a time. The engineer, for a wonder, refused to do this, so they piped the boiler blow-off into an old well. This bank had total deposits aggregating about $32,000,000.

On another job where I was employed, they had machinery as follows: Two 100-hp water-tube boilers, two 55-hp McIntosh & Seymour engines, direct-connected, one 75-hp Ames engine, direct-connected, one vertical fan engine, one three-cylinder fan engine, two sets of hydraulic elevator machinery in a double deck, one feed pump, one bilge pump, two elevator pumps, feed-water heater, auxiliary heater, switchboard. All of this and a lot more was jammed into a hot, ill-smelling place 45 ft. below the sidewalk. The space was full of a complicated snarl of pipes and wires of every size and description and for every purpose, running in every direction.

The boilers were crammed into a little space so close together that one could not get at either sides or top and could scarcely crawl in between. When anyone came near these two boilers they would be hit on the head with scalding hot drops of water, that came from innumerable leaks that were in such inaccessible places, that it was almost impossible to repair them. All the piping throughout the building was of iron, butt-welded and laid in cement. The building is only about ten years old, and serious leaks are breaking out every week in the most unheard of places.

The wiring is all concealed and there is no definite plan of order to it. Two and three-wire systems are all mixed up, junction boxes everywhere and in places where no sane man would ever think of looking for them.

In another plant where I once worked, a large hole had been excavated underneath a side street and two boilers and a hydraulic elevator outfit dropped into it. Entrance and exit were provided for by a little oblong hatch and a very steep and slippery old iron ladder was thoughtfully provided. In the summer time the air in this hole was unendurable; one would almost fall to sleep on entering.

In another case I know of, two 6-ft. boilers were jammed in together in such a diabolical fashion, that in order to get at the blow-offs, one had to climb over the tops of the boilers and down the back. If anything should let go at that time, I do not know where the engineer would be.

I could give many other cases, and go on in this fashion indefinitely, but I think the foregoing will suffice for the purpose of illustration.

Allston, Mass. E. L. Griggs.

MR. COOK'S PROBLEM IN SIGNALING.

I submit the following solution to Mr. Cook's problem in signalling published in the August number of the Electrical World. The problem was to have a system of bell and buzzer signals for use in three offices so arranged that signals could be sent from any room to any other room in such a manner that it would be known whence the signal came. As stated the result must be accomplished in a practical way, using only ordinary push buttons, bells and buzzers, together with a minimum amount of wire.

The accompanying diagram, Fig. 1, shows a practical way for wiring such a system. In each room is placed a bell, buzzer and

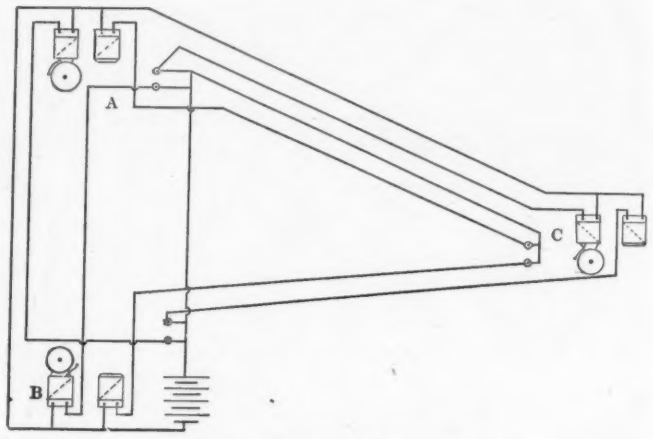


FIG. 1.—MR. O'DONNELL'S SOLUTION.

two push buttons. If a signal is received in room *A* the ringing of the bell would indicate that it came from room *B* while the operation of the buzz would indicate that the signal came from room *C*. In a similar manner one of the push buttons in room *A* would operate a signal in room *B*, while the other would operate a signal in room *C*. In this way it is possible to signal any room desired from any other room and also to know when signalled whence the signal came. Only one set of batteries is required, connected as shown.

Olney, Ill. T. E. O'Donnell.

I submit the enclosed diagram (Fig. 2) as a solution to Mr. C. E. Cook's problem in signalling published in the August issue of the Electrical World. In the diagram *B* represents the bell, and *Z* the buzz. The push buttons are properly designated by number.

Referring to the diagram it will be seen that pushing but-

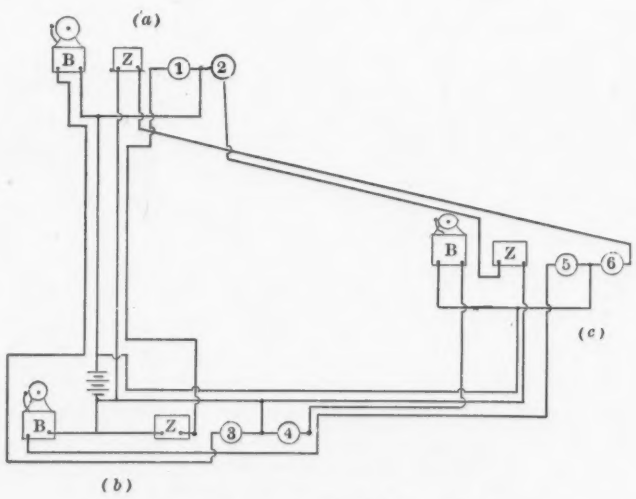


FIG. 2.—MR. TRAMBLEY'S SOLUTION.

ton 1 in room *a* operates the buzz in room *b*. Push button 2 controls the buzz in room *c*. Push button 3 controls the bell in room *a*. Push button 4 controls the bell in room *c*. Push button 5 controls the bell in room *b*, and push button 6 controls

the buzz in room *a*. One set of battery is all that is required.

St. Louis, Mo. H. P. TRAMBLEY.

The accompanying diagram (Fig. 3) shows how Mr. Cook's problem in signaling can be readily solved. As will be noted from the connections, which are very simple, a minimum amount of wire is used and all the other conditions of the problem are fulfilled.

Detroit, Mich. C. JONES.

[Similar solutions were also received from C. T. James, Brooklyn, N. Y.; J. Hazerick, Albany, N. Y.; H. Flood, Kalamazoo, Mich.; J. McManus, Oakland, Cal.; O. A. Kenyon, Baldwinsville, N. Y.; Frederick Neesby, Chicago, Ill., and E. Griffiths, Denver, Colo. Mr. Cook's solution to his own problem is shown in Fig. 4.—EDITORS.]

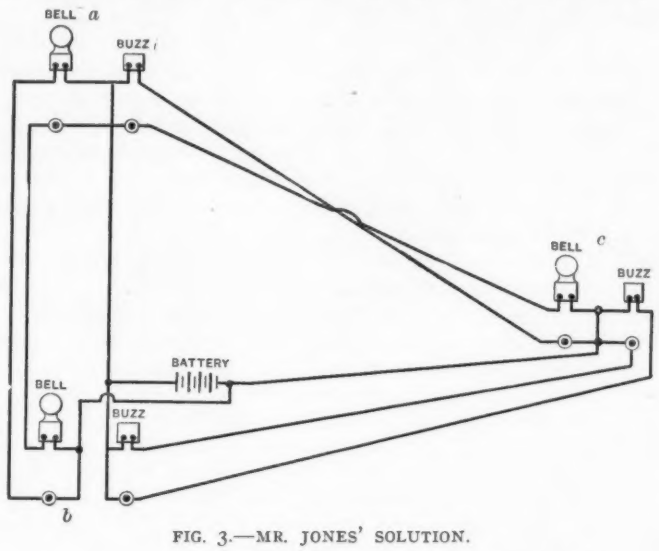


FIG. 3.—MR. JONES' SOLUTION.

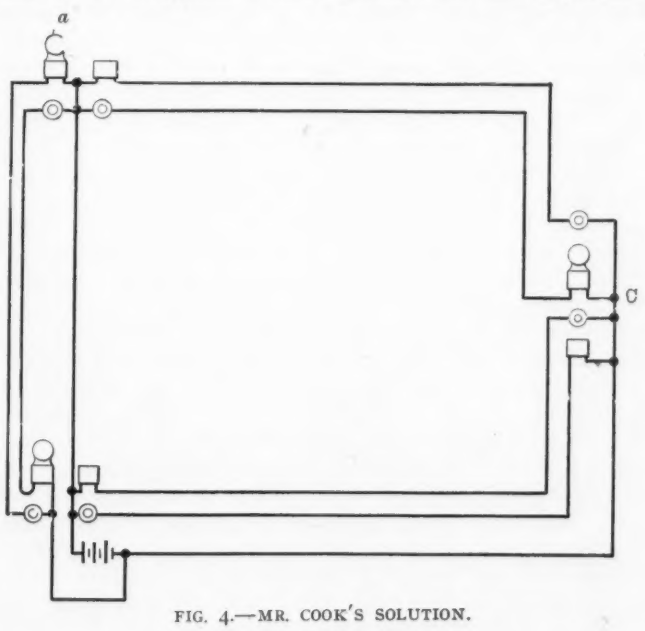


FIG. 4.—MR. COOK'S SOLUTION.

STARTING AND STOPPING DYNAMOS.

In the August issue, J. N. Thomas asks opinions on starting and stopping dynamos, and whether or not it is harmful to leave all the switches in all the time. Now opinions differ most decidedly as to which is the better method. When the switches are not disturbed it is easier and quicker to start and stop. I never could discover that the dynamo was ever injured by doing this, and it saves sparking at the switches.

On the other hand, if the switches are never opened, they are liable to corrode and stick, so as not to be easily opened when most needed. On a machine that is very slow in building up its voltage, it may save a little time to have the load all off until it has increased its voltage to the normal value.

On a good many small steamers that have a small lighting plant, it is customary to locate the switchboard in the engine-room on the lower deck, and have the dynamo and engine away down in the hold. In such a case it is the invariable practice to start and stop without ever disturbing the switches or voltmeter. I go aboard of these boats year after year and I never could discover that the dynamo was any the worse for this treatment; the boat always seems to be well lighted. I have often operated and had charge of dynamos, and have often run them for weeks without ever disturbing a switch.

Allston, Mass. E. L. GRIGGS.

THE UNEXPECTED WHICH HAPPENED.

After many years experience in designing, constructing and erecting machinery, the writer has become very skeptical regarding the condition of machinery and drawings as sent out from shop or office to field; so skeptical in fact, that no machine will be accepted and started without first thoroughly examining it, and giving each part a most thorough overhauling exactly as if it were a second-hand machine which was purchased upon its merits.

A rigid adherence to the policy outlined above, has more than once prevented serious trouble and prevented the writer from getting into more than one serious difficulty. For instance, an engine of the Corliss type from a well-known builder was to be placed in a factory, but in accordance with the "take nothing on trust" policy, the engine was taken down completely, piston taken out, and every portion of the machine taken apart. As a result of the very close examination thus made, more than four pounds of molding sand was taken from the steam ports of the engine. Imagine the trouble which would have happened had the engine been started with all that sand ready to feed gradually into the cylinder? And doubtless, many an engine has been mysteriously damaged from the same cause. The writer has found core sand in the ports to be a very common thing in engines of more than one make.

It seems queer engineering to be anticipating the unexpected, but such a course goes far toward constituting good engineering, however "queer" it may seem. In another engine, of the throttling governor, slide-valve type, it was found that the valve stem had to be sprung out of line in order to get the stem into place. Chipping around the nut in the valve, cured the trouble.

It is not the intention of the writer to cast any insinuations against the work turned out by engine builders—far from it—but merely to call attention to the fact that to anticipate the unexpected—to discount it, in fact—eternal vigilance on the part of the man in the field is necessary to counteract the human factor which enters into the manufacture of all machinery. As long as machines are made by men, so long, especially under the contract system of machine building, will there be the necessity for "suspicious inspection" on the part of the engineer in the field.

In another instance, where a "test card" accompanied the engine, bearing testimony to the fact (?) that the engine had been erected and operated for ten hours under steam in the shop, it was found necessary to bore out the eccentric three-eighths of an inch in order to get it on the shaft.

In another case, it was found that the wheel governor would stick when in a certain position—a most excellent argument for examining closely the governor of every engine handled, to take down the governor mechanism and to know from personal inspection that things are as they should be. This engine gave trouble from the start. It would run slow at times, and then race, the lamps going up to full candle power, then down to a good deal below normal, thereby causing a wave effect in the light which was very far from being appreciated by the patrons of the plant.

Being attracted by the change in brilliancy of the lamps the writer went to the station and found the attendants trying in vain to "quiet down" the engines so they would drive the generators steadily. In vain they tried everything they could think of, but the "waving" continued until the writer asked

permission to try his hand, which being granted, he closed the throttle until the governor ceased to act and the lamps burned rather dimly. This took only a few seconds and then the throttle was slowly opened again until the governor caught the load again, when the lamps all started to burn brightly and steadily without a flicker or a "wave." The reason is very simple; closing the throttle until the governor ceased to act gave that appliance a chance to settle down from its oscillating caused by sticking, until the increase in speed was sufficient to overcome the inertia created by the unnecessary friction of the governor parts. Once the oscillating was stopped, the engine would run smoothly until the sudden throwing on or off of load caused the speed to fluctuate again within limits of the sticking of the governor.

Another engine gave trouble in a most unexpected way indeed. This prime mover was started up without having been overhauled. In fact, it was put to work just as it came from the maker, and before it had run an hour the engineer was given a shock by finding what seemed to be babbitt metal coming out of the rod stuffing box. A copious application of various kinds of oil failed to stop the outpour of white metal, which took place by fits and starts at intervals of a few minutes. It was found that there was no metallic packing in the stuffing box, so the soft metal could not come from there. Finally, the writer being asked to suggest an origin for the eruption of metal, took a small thread of the stuff, and held a lighted match under it and found with a good deal of surprise that the metal melted about like wax. Here was a clue; the metal was not babbitt, but bismuth solder which melted below the temperature of steam, becoming liquid at about 180 degrees, thus melting readily in boiling water. A close examination developed the fact that the man who made the gland had bored it out of center, and spoiled the piece unless something could be done to plug the old hole and bore a new one. To this end, the workman filled the wrongly made hole with soft metal and bored a new hole for the rod, in its proper position. But instead of filling the original hole with babbitt metal, and thereby giving himself away to the inspector or to the foreman, that too bright workmen actually filled the hole with bismuth solder which he could melt with hot water, thereby making it possible for him to fill the hole without being detected. This is one of the "unexpected" things which happen in spite of the most rigid inspection of piece-work in the best equipped and thoroughly organized factories.

Another unexpected thing happened when an eight-inch pipe in a power plant persisted in leaking in one of the screw fittings, in spite of all that could be done to prevent. All the calking that could be done failed to stop that particular leak, and attempt after attempt was made until finally, in despair, the leaky connection was taken down, when the cause of the trouble was at once apparent. The workman who threaded the pipe, from some reason or other, got the pipe too small to make tight in the fitting, so he covered a piece of copper wire cloth of very fine mesh with red lead, and screwed up the joint with the wire gauze between the pipe and fitting. This made the joint an apparent fit and it was passed by the foreman; but the difference in the ratio of expansion of the steel and the copper wire cloth proved fatal, and the joint always leaked. The engineer, after a little reflection, replaced the defective joint with another piece of wire gauze screwed inside, but he took the precaution of using iron wire cloth instead of copper. It cured the leak, and there never was any more trouble due to that particular leak.

In an electric light plant not 1,000 miles from Hartford, Conn., the sight-feed oiler suddenly blew out of the main steam pipe, the thread stripping out of the pipe. Here was a "state of things." The engineer did not dare run the engine without an oiler, and he did not want to shut down the generators to make repairs.

In a few minutes Yankee ingenuity triumphed; a pine plug was driven into the hole in the pipe to stop the flow of steam until preparations could be made to handle the "unexpected" repairs. It was found necessary to tap a new thread in the pipe, screw in a bushing and insert a piece of ⅜-inch pipe with 120 pounds gage pressure of steam inside the 8-inch pipe. The engineer placed the proper tap in a bitstock, an ordinary carpenter's brace, and then pushed the tap through a very small hole in the middle of a piece of heavy packing about 24 inches in diameter—the center left from packing the top of a heater. Getting behind the shield thus extemporized, the engineer pulled the plug out of the hole in the steam pipe, inserted the end of the tap, and with the brace quickly tapped the hole out to the proper thread, the steam all the time hissing around the shield of packing. The thread being cut as quickly as it can be told of, the steam pipe was thrust through the same hole in the packing and as quickly screwed into place, thereby completing in ten minues repairs which threatened to stop every light, and which would have been the case had the engineer not been ready for the "unexpected" with both hands and head.

A 100-hp motor recently installed in a factory erected by the writer was belted to a line of shafting nearly eighty feet long, to which was attached by means of pulleys of various sizes, many belts leading away from the shaft in many directions. A large number of men, carpenters and machinists and laborers, were employed about the factory, getting the various machines into condition for work.

It was found to be necessary to start the motor and the shafting frequently, and it was quite a task to see that all the men were clear of the belts before starting up. It became so great a task to clear the men away from danger that a piece of steel ⅛ inch in diameter, and four feet long, was bent into the form of a triangle, and suspended near the motor. Instructions were issued that the triangle be struck with a conveniently suspended hammer before starting the motor. The men got to depend upon the sound of the triangle, which was very sharp and piercing, and easily heard in every part of the factory, and they would jump out of danger the instant its sound was heard.

But one of the men forgot to sound the alarm and started the motor, nearly catching a carpenter who was working among the belts. This occurrence led the writer to make the alarm automatic by putting a lot of extra wire into the first wire leading from starting box to rheostat or choke coil. The extra wire was wound around a piece of 2-inch round iron, bent U-shaped, virtually forming a horseshoe magnet, the armature of which was attached to the hammer of the triangle, by means of a spring. When the starting lever was put in the first notch the hammer would hit the triangle a terrible "whack" and the men jumped to safety. The device never failed or forgot. It was a sure thing and there was no more danger from belts or from forgetful workmen in that factory.

Boise, Idaho. James F. Hobart.

TIGHT AND LOOSE MAIN BEARINGS.

Visitors to engine rooms sometimes criticise what they see and unjustly blame the engineer for what he cannot help. As illustrating this point, I was in charge of an engine that was heavily loaded, and was not shut down from Monday morning until Saturday night unless an accident made it necessary to stop. If the main bearing of that engine began to heat it was almost impossible to stop it, and if the machinery was stopped it caused serious loss to the owners.

Under these conditions I felt justified in allowing the quarter boxes to run loose, although it made them pound every time the crank pin passed either center, and by watching the center of the shaft, lost motion could easily be detected. While this was not satisfactory it was better than to be obliged to shut down and cool off a hot box.

When the load was light occasionally, the lost motion seemed to be much less, and the pounding almost disappeared, and on another engine that was never heavily loaded I could let the quarter boxes run quite loose without trouble, and nobody could tell by sight or hearing that they were not well keyed up.

This shows that a smooth and quiet running engine is often due to conditions more than to skill on the part of the engineer, while he has to exercise much more ingenuity to keep another one in continuous operation, although it makes more noise than the one for which he receives much credit. While this does not seem fair there seems to be no remedy.

Boston, Mass. B. R. Johnson.

QUESTIONS AND ANSWERS.

I am operating a number of shunt dynamos and notice when I close the main switch first the machine picks up very slowly. Why should this be? E. C.

The resistance of the main line is so much less than that of the field coils that the small e.m.f due to residual magnetism causes a much larger current in the armature than in the shunt field. When this is large the cross and back magnetizing force of the armature weakens the field more than the initial field current strengthens it, so that the machine cannot build up, or else builds up slowly.

Why is a magneto test for grounded armatures not recommended; I note in one of your back numbers a statement to the effect that this test is misleading? J. R. N.

Armatures frequently have sufficient static capacity to enable a magneto to ring even without a leak. This is due to the fact that the magneto gives an alternating current. When the circuit has capacity it acts as a condenser and at each turn of the armature of the magneto, a rush of current goes out to charge the surfaces of the condenser, ringing the bell on the way. When the armature has made another half turn, the current rushes back and the condenser is charged in the opposite direction.

What type of boiler feed pump should be used for feeding hot water to the boilers? E. R.

A boiler-feed pump of the piston type is usually used for medium boiler steam pressure. The piston is packed with a special packing for this service which is very hard and is not liable to shred away owing to the action of the hot water. With water free from grit, a piston pump packed with babbitt rings has given satisfaction. Where high boiler pressures are maintained an outside packed plunger pump is usually installed. The water valves of the pumps should be either of composition or hard vulcanized rubber.

I have two 15-kw, 60-cycle transformers with 5,000-volt primaries and 110-volt secondaries. I wish to use them on 2,300-volt primaries and 110-volt secondaries and would like to know if I could have them rewound or changed in some way to obtain the desired result? C. A. I.

A 5,000-volt to 110-volt 60-cycle transformer can be arranged to operate from 2,500 volts to 110 volts if the primary is divided into two parts and connected in parallel instead of in series as is now the case. In order to operate the primary at 2,300 volts, it would be necessary to remove 2/25 of the primary turns, or rather, it would be necessary to connect the primary coils so as to include 23/25 of the primary turns. This work can be accomplished by anyone familiar with the construction of transformers and it will not be necessary to completely rewind the primary.

Is it possible to start up a 2,500-hp steam turbine quicker than a reciprocating engine of the same capacity, granting that both were cold at the time of starting? F. L. O.

It has been frequently claimed that a steam turbine may be started up in one-quarter of the time required for starting up a reciprocating engine. A Curtis turbine of 1,500-kw capacity has been started and phased in on the line in thirty seconds after having stood twelve hours, and survived the shock; but we should not care to recommend such treatment. Turbines have been started up in emergencies in from 2½ to 3½ minutes. We have never heard of a large reciprocating engine being started up in so short a time. Good practice, however, should demand fifteen minutes at least; especially if superheated steam is employed. Where turbines are started up quicker than this, the tendency of the machine to hump itself out of shape owing to the unequal expansions which must necessarily ensue, is too great a risk to be ignored.

We have direct-current series enclosed arc lamps taking 6.8 amperes with 70 volts at the arc and wish to change these so as to operate them five in series on a 500-volt street railway circuit. What changes will be necessary? C. L. & T. Co.

This depends on the make of lamp employed. Almost all the constant-current series lamps on the market will work in multiple-series on power circuits. To provide for independent operation of each lamp on a multiple-series circuit and to insure against the interruption of the group in case one lamp is cut out, each lamp should have a resistance in the casing equal to the resistance of the arc. In case of accident or cutting out this should switch automatically into circuit so that the other lamps in the group will continue to burn normally. The lamps may be provided without external rheostats in which case the interruption of one lamp may extinguish the group, or if automatic cut-outs are provided to cut out the lamp from circuit, a higher voltage will be impressed on the other lamps.

We are operating compound-wound generators which at times carry violently fluctuating loads. When considerably increased loads come on suddenly there is a momentary drop in voltage notwithstanding the compound-wound field. Is it possible to remedy this annoying defect? D. J. O.

The drop is due to the difference between the time constant of the series' field winding and that of the resistance strip connected in shunt to it. For example, when the heavy load comes on the shunt strip having no inductance presents only the opposition of resistance to the increase in current; whereas the series winding is self inductive and its reactance opposes momentarily the sudden increase in current flow through the windings, so that before the current through the series coils attains the value which it would have if opposed only by the resistance, the voltage of the machine is cut down by armature reaction, etc. As a remedy for this condition Mr. H. M. Hobart has taken out a patent based on using an inductive shunt instead of a plain German silver strip, the time constant of the inductive shunt being made approximately the same as that of the series winding of the generator.

We have great difficulty in keeping our electric signs white notwithstanding that we use the best white lead obtainable and paint the signs once a year. After they have been in service a short time the color changes, and at the end of nine months the signs have a dirty lead color. Can you suggest any remedy for this, as we wish to keep our signs as white and as neat as possible? J. T. C.

Paint your signs with French zinc and raw oil instead of with white lead and they will always remain white. The reason for this is as follows: White lead paint is a carbonate of lead ground in oil. Where minute quantities of sulphuretted hydrogen gas are present, this acts chemically on the lead carbonate and forms sulphide of lead which is a black compound. This accounts for the change in color of your signs. If, however, the blackened surface remains exposed to the light and air, it is bleached again, the sulphide being oxidized and converted into white sulphate of lead; but this does not take place in the dark, nor even completely in the light. On the other hand, if zinc white is used the sulphuretted hydrogen gas has no effect on it and this is an important consideration in manufacturing towns where that substance is so abundantly supplied to the atmosphere. Unfortunately, however, the zinc is somewhat more expensive and does not cover as well as lead, and for all ordinary purposes, however, where cost is not a consideration the zinc is as serviceable as lead, and where permanent and superior whiteness is desired white lead is not to be considered.

A 110-volt, 20-ampere shunt dynamo is used on board a yacht to charge storage batteries. A double-throw switch is provided on the switchboard so that when it is thrown up the batteries supply the electricity for the lamps while the dynamo is shut down, and when the switch is thrown down the dynamo charges the storage batteries. Some one at night had accidentally thrown down the battery switch when the dynamo was shut down and the dynamo made three or four revolutions before the switch could be opened. When the engine was started up in the morning the dynamo would not generate and the voltmeter needle tried to go the other way. How can the dynamo be made to generate properly? D. C. B.

It is evident that the polarity of the shunt-wound dynamo has been reversed by the incident mentioned. In order to re-reverse the polarity it will be necessary to lift the brushes off the commutator and close the battery switch. This will permit the current from the battery to flow through the field coils, but not through the armature. After a few seconds the battery switch should be opened very gradually so as to draw out an arc. When the switch is open the brushes may be replaced on the commutator and the engine started as usual.

CENTRAL STATION SALE OF CURRENT

Methods of Building Up the Day Load of Central Stations, as Practiced in Danbury, Conn.

By C. R. Hodgson.

Is a good day load profitable to a central station? The answer is, decidedly, yes! Then get busy, Mr. C. S. Manager, and leave your office for about five hours a day and make personal calls on the manufacturers in your city. There are a great many factories within easy reach of your service lines, and you will find that only a very low percentage of them are running as economically as is possible.

Ask permission of the factory owner himself to allow you to make a tour of inspection for the purpose of telling him how he can increase his profits. This permit is rarely if ever refused, and it costs him neither time nor money. Make a note of every power-driven machine he has, the number of bearings on the shafts, and how many belts would be eliminated by the installation of electric motors, with a motor for each power-driven machine; point out to him, when the time comes, just how much he will save on belts, oil, waste, engineer's wages, etc. Then, after you have done this, ask him to allow you to indicate his engine; do this free of any charge whatever, taking no less than thirty cards for his full load, and no less than ten for his friction load. He will be very glad to get these cards to see what his engine is doing, and see what it costs him per hp-hour to run his engine and boiler.

After you get all this data as to shafts, belts, etc., and with the cards all worked up showing the horse-power being developed by his engine—which is a very easy matter with an improved planimeter made especially for this purpose—you are loaded for a very convincing argument as to *why* he should equip his whole factory with the individual motor drive.

First, inform him as to his load. Say that it is 100 hp, for example, with a friction load alone of possibly no less than 35 indicated hp, which he is paying for every time his engine turns over. This you can save for him—put in his pocket; then you can also put the engineer's wages in his pocket—more profits. Don't neglect to use the word "profits" freely; they all like to hear it, for it sounds to them as the rippling waters of a brook sound to a man dying of thirst.

With these two items—saving of this friction load and engineer's wages—you have a good starter, and will have him interested. You must not talk price of motor until you have shown him the saving he will make when changed over. Keep those increased profits firmly fixed in his mind, and constantly before him. Explain to him the saving due to the intermittent operation of the machines, and follow it up with the fact that with the motor he only pays for what he uses. It goes the European plan one better, inasmuch as he not only pays for what he gets, but he gets what he pays for, and more.

When work for the day is finished on any one machine it is shut down by the operator—hence the saving. Explain to him your service; that you can furnish him with power every day, all day, the whole year round, so that in case of rush work he can run Sundays or any night and will not have to pay fireman or engineer overtime wages. Tell him the motor connected to your service lines will run at an absolutely constant speed, so he can depend on a machine to run at a set speed without any variation whatever; and, in view of the fact that the machine operated by a motor does run at a constant speed, it is plainly seen that the production will be increased materially.

I have in mind an instance of this kind which goes to show how much of an increase in production can be gained by using the electric motor for individual drive. In this case, here in Danbury, Conn., I installed a motor for the purpose of demonstrating its operation on a machine known to the hat manufacturers as a five-section blower. The function of these machines is to refine the fur used in making felt hats. The fur ranges in price from $1.50 to $5.00 per pound, and some grades go even higher than this in price. There were two of these five-section blowers in operation side by side; on the one we connected our motor, and the other was left belted to shafting operated by the steam engine. Both machines were timed at start and found to have the same speed and the same grade of fur was "blown" in each machine. Each day of the two weeks during which this test was going on, the motor-driven machine showed an increase of finished product, due to the unvarying speed of the motor, of from 25 to 40 pounds of fur, the machines running exactly the same length of time. It is needless to say that the manufacturer adopted the electric motor for power. This was the Peck Fur Company, of Danbury, Conn., which has since built a new factory in which there is no shafting whatever.

It is always my final argument with a prospective customer to tell him I will, at no expense to him *whatever,* install a motor, any size up to 15 hp, connected to any machine in his factory he may designate, and allow him to operate it for thirty days; there to be absolutely no charge made to him for electricity motor or labor, or anything else; this I do when I know what can be done with the electric motor. I also connect in a watt-hour meter and tell him each day what it would have cost him for energy for the previous day, thus showing him exactly what the operating expense would be.

I have never but once in my experience found a manufacturer who would refuse this last offer. If, as a last resort, central station managers would use this last-named argument, I think they would find little difficulty in building up a day load. The old phrase, "Nothing ventured, nothing gained," should not be disregarded.

The New Business Campaign at San Antonio, Tex.

The San Antonio Gas & Electric Company is one of the American Light & Traction Company's properties, and, as might be expected, has been conducting a new business compaign along lines similar to those in use at Denver, Col., St. Paul, Minn., and Madison, Wis., described in recent issues of this paper.

The commercial department was started in the fall of 1904 by Mr. D. N. Warwick, who came from the new business department of the Denver Gas & Electric Company to inaugurate the new business campaign in San Antonio. As a result of this campaign, San Antonio now presents the best appearance at night on its down-town streets of any city in Texas, although there is still great room for improvement by increasing the standard of illumination in many of the smaller stores, as this standard is at present very low. In few cities of the size in this country are so many small stores to be seen lighted by bare lamps on drop cords hung in rows over each counter. This arrangement in itself is not bad, because for a few dollars it can be changed into a very efficient and handsome lighting arrangement, but the great trouble in San Antonio is that in many of the smaller stores so few lamps are used. This is not so much due to any lack of enterprise on the part of the San Antonio storekeepers or central station people, as compared with those in other towns, as to the fact that many of the small stores in San Antonio use electric light where in other cities they would use gas. A large class of small customers therefore is connected to electric light service which in other cities would very likely think they could not afford it. The hot climate of San Antonio is such as to make gas lighting almost unbearable during a large part of the year, and the policy of the company has been not to push gas for lighting.

In the residence districts, electric light is generally used in preference to gas, as in residences also gas light gives off so much heat as to make it a burden to the flesh, where the temperature is already in the neighborhood of ninety.

The increase in gross earnings from gas and electricity from April, 1905, to April, 1906, was about $47,000 over the previous year. The cost of maintaining the commercial department for one year was about $7,000. During 1905 the gas output was increased 46 per cent. The increase in electric output was 26 per cent. The load on May 17, 1906, was a maximum of 1,090-kw in alternating- current lighting and 188 kw in direct-current 9.6-amp. arc lamps. The rapidity with which the business is growing is illustrated by the fact that the maximum 1905 peak was 1,532 kw, while during the spring of 1906 a peak of 1,589 kw was reached. The average demand on the 500-volt direct-current stationary-motor service is 330 kw. San Antonio had a population in 1900 of 53,321. The connected load in May, 1906, was 1,500 hp in stationary motors, 375 direct-current open 9.6-amp. arcs and the equivalent of 67,425 in 50-watt incandescent lamps, this latter being an increase of 9,552 over the same date last year. Besides this there are 153 alternating-current arc lamps, 212 alternating-current fans, and 2,263 Nernst glowers. The Nernst lamp business shows the most remarkable change of any, as there were only 646 Nernst glowers a year previous. The number of customers in the business district was 1,250 and in the residence district 3,750. The sign business has been very actively pushed, with the result that there are 61 signs on a flat rate similar to that in use at Denver, Col., and Madison, Wis. Besides this there are 19 contracts for outlining buildings and 58 for show-window lighting. The sign business amounted to 6,987 in 4-cp lamps burning every evening, all the evening. Besides this there are 1,172 4-cp lamps on meters connected to signs, show windows and decorative outlining circuits.

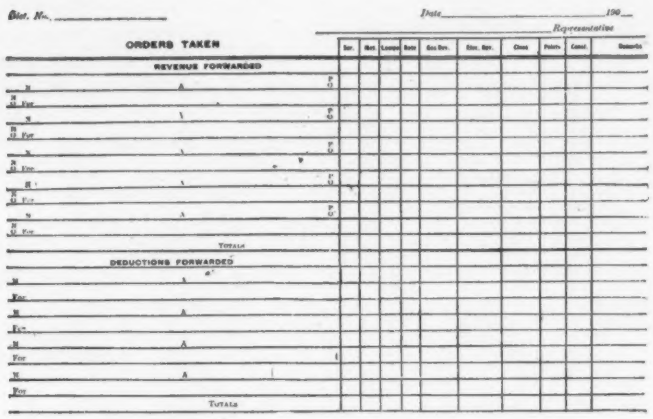


FIG. 1.—SOLICITOR'S REVENUE RECORD, SAN ANTONIO.

SECURING NEW CONTRACTS.

The city is divided into four districts. This division is made as evenly as possible as to the possibilities of the territory. Each district is assigned to one solicitor, who makes from 20 to 30 calls a day. The solicitors turn in reports of calls made and division of time on blanks provided for the purpose. A solicitor's record of business turned in from day to day is kept on the opposite side of this blank, as shown in Fig. 1. It will be noticed that account is kept of business lost in a man's territory as well as new business taken in as it is the net business that counts. The letters P and O at the right of the address column are to indicate whether the business was taken personally by the solicitor or came in through the office. The letters N and O at the left of the names colmun indicate whether the customer is new or old. The commercial department consists of four solicitors, a manager, an application clerk and a stenographer. Solicitors' meetings are held the first thing Monday and Wednesday mornings. It is not considered necessary to hold them oftener as with so small a soliciting force all have ample opportunity to talk with the manager personally. Solicitors are paid a salary.

SPECIAL NERNST LAMP PROPOSITION.

A special proposition for the installation of Nernst lamps is made to merchants. By this a merchant pays for his lamps along with his regular monthly bills during a period of two years. To arrive at a customer's monthly bill under this arrangement the cost of the lamps and wiring is divided by 24. To this is added the regular readiness to serve charge of the Doherty rate and whatever bill there is for energy consumption. The readiness to serve charges on Nernst lamps are as follows. If the consumer owns the wire: 3-glower, $2.75 per month; 4-glower, $3.25 per month; 6-glower, $4.30 per month. If there is more than one lamp deduct $1 for each lamp. If the company owns the wiring: 3-glower, $2.90; 4-glower, $3.40; 6-glower, $4.50.

REGULAR RATES.

The regular rates in the business district are on the Doherty readiness to serve plan and consist of $1 per month per customer service charge plus 15 cents per 50-watt lamp connected, plus 6 cents per kw-hour for whatever electrical energy is used. In the residence districts the rate is 16 cents per kw-hour.

ARCH LIGHTING.

The two principal streets are lighted by 4-cp incandescent lamps on arches. One of these arches on Commerce Street is shown in Fig. 2. This is a narrow street and each arch has 16 4-cp lamps. On Houston Street, the other principal thoroughfare of the city, the arches have a longer span and have 25 4-cp lamps. These arch lights are paid for by merchants' associations and add very much to the festive appearance of the down-town district at night. The rate for these lights is the same as for flat rate sign lighting, which is turned on and off by the company; or, in other words, it is the same rate as would be paid by any merchant in the business district under the Doherty contract were he to burn his lamps the same number of hours as called for in the flat rate sign or street lighting contracts.

FIG. 2.—ELECTRIC ARCH IN COMMERCE STREET, SAN ANTONIO.

Hints on Securing New Business.

At the Atlantic City Convention of the National Electric Light Association the subject of methods used in securing and retaining business was discussed by Messrs. Mathias E. Turner, Norman T. Wilcox, George N. Tidd, R. S. Wallace, George B. Tripp and Leon H. Scherck. From this discussion we extract the following parts relating more particularly to specific methods of securing new business.

Mr. Turner pointed out the desirability of placing at the service of architects, engineers or tenants expert advice on the most economical and most modern methods of electrical work, to submit specifications and estimates of expense for the installation of electrical equipment and to secure for them proposals for its ex-

ecution. Much good may be accomplished through the efforts of illuminating engineers working in conjunction with solicitors, the part of the former being to analyze the illuminating value of existing installations, advise the canvasser as to the arrangement and kinds of electric lamps to give the most effective light at minimum expense, and estimate the cost of doing the necessary work. A sales department should thus have its efforts complemented by the work of illuminating and mechanical engineers who make a study of illumination and power economies, who keep posted on the newest and best in the line and who can estimate closely the cost of work.

Recently in Cleveland the electric lighting company introduced and advertised a method for equipping old houses for electric light, payment for such equipment to be made on the installment plan to a wiring contractor. Two canvassers were sent out to solicit business on this basis, and have secured business at a remarkable rate and at a minimum expense to the company with respect to line investment.

Mr. Norman T. Wilcox said that his company has recently taken from the operating force men of good address who are ambitious and willing, and has given them definite districts in which to work, and supplied them with high efficiency and other lamps and necessary apparatus for making demonstrations on the prospective customer's own premises. If there is no supply wire on the premises, a temporary device is run for this purpose. In the case of prospective motor customers, the motor is installed and run a few days free of charge. Solicitors are encouraged to make occasional calls on customers to see if their lamps are operating properly and to make suggestions as to the better placing of illuminating and other devices. The expenditure of considerable money for demonstrations, installing appliances on trial, etc., will be amply justified, and would make many central station managers wonder why they had neglected this old-fashioned method of getting business.

Mr. George N. Tidd recommended that electric irons and all kinds of heating devices, sewing machine motors, etc., be installed upon two or three weeks free trial. His company makes engineering tests of isolated plants in order to determine their cost of operation. In the mill or factory the steam plant is shut down, motors installed throughout upon trial, and the saving, convenience and reliability thus thoroughly demonstrated. Mr. Tidd believes in a variety of forms of contract. His company has, in addition to the ordinary meter rate, a two-rate contract on the Wright demand system; a flat-rate contract; a flat-rate sign contract; a wholesale quantity basis, based on long-termed contract with high guarantees, and a flat-rate power contract avoiding overlapping peak.

Mr. R. S. Wallace advised that if the conditions compel a choice of either solicitors, general advertising and direct-by-mail advertising, it should lay with the solicitor, and strenuous efforts made to keep him permanently employed. In the case of small plants the solicitor should be in the office when accounts are being paid, in order to handle complaints. He considers it a mistake to pay solicitors a commission on appliances sold, and advises a flat salary. A combination of a flat salary and a commission based on actual sales of electricity, graded in accordance with the investment required to make these sales and its relation to the peak load, is the ideal method of composition, but requires considerable clerical work. A solicitor should be selected, first, for his ability to handle people, and should report every day to the manager and discuss with him his orders and his prospects. He should have access to the electrical journals and his attention should be especially directed to any article that it is considered would help him.

The selling price of appliances should be at the same rate of profit that a dealer would expect, but every cent of this profit should be put in advertising or soliciting. This practice will encourage dealers to handle electrical appliances, and the more people in the territory who can be induced to push electrical appliances, the better it will be for the central station company. The practice of selling appliances at cost or less than cost has the tendency to confirm the popular opinion that great profits are derived from the sale of electricity. Appliances, however, should be offered to customers on trial long enough to demonstrate thoroughly their convenience and utility. Friendly relations should be established with contractors, and their criticisms and suggestions should be well received and considered. Mr. Wallace warned central station men to be chary in the use of circular letters, and not to place too much faith in the selling power of multi-colored direct-by-mail stuff artistically folded like a table-cloth or a bed-sheet. The chief value of a circular letter is its personal appeal, and consummate care should be given to impart to it this character.

Mr. George B. Tripp recommended that a manager should be placed in charge of the business department, the territory divided into districts and a solicitor detailed for each district. One man can look after and solicit from consumers in a territory of from six to eight thousand population. Solicitors should be paid either on a commission basis or a small salary plus a commission, and they should acquire a fair knowledge of the devices which they are to sell. Referring to electric sign business, Mr. Tripp said that in Colorado Springs contracts have been secured for 40 electrical signs yielding gross earnings of about $3,500. The contract provides that the consumer shall install the sign at his own expense and that the company shall charge a flat rate for energy consumption and maintenance of lamps on the four-hour per day basis. Residential lighting has an average demand of only about 1½ hours as compared with four hours daily in sign lighting. Before starting the electric sign campaign, his company convinced the city council of the desirability of an ordinance permitting the installation and erection of electric signs projecting over the sidewalk, the main argument being that thereby the streets would be more adequately illuminated and they could be placed more easily and at a less expense, and that the interest of the business men and taxpayers would be enhanced because of the brilliantly lighted main thoroughfares. A considerable and growing demand for electric flat irons has been experienced, which are sold at cost and add, at a conservative estimate, $10 per iron per year to the company's earnings.

Mr. Leon H. Scherck advised that in the organization of a contract department, the man at the head should be of a type who can properly meet the president of a bank one minute and an ignorant peanut vender the next. He should either have or should acquire a general knowledge of the technical part of the business, and be able to impart such part of the knowledge as is necessary to his solicitors. It has been found a good practice to hold weekly meetings of all solicitors and to have the manager, superintendent or head of the meter or other departments make an address at these meetings. For example, a meter is taken apart and its workings explained; an arc lamp is shown and the solicitors see how it performs, or a motor is tested and the details of the test explained. His company has succeeded in building up an immense sign business in several cities (in one place nearly 60 cents per capita) by furnishing, erecting and maintaining signs at a flat price per month on contracts of from one to three years. It was at first confronted by laws forbidding the erecting of signs across the sidewalk, but the city councils of the several cities were brought to recognize the fact that electric signs lighted up the streets free, and ordinances were passed not only granting permission for electric signs, but compelling their use, where installed, until at least 9.30 every nght and requiring a certain number of lamps per square foot of sign surface. The privilege has also been secured of suspending signs under certain conditions across the streets.

While not favoring free wiring in general, Mr. Scherck cites the following plan which in practice brought in a surprisingly large amount of business: The company offered to wire six outlets in a place, the consumer paying for the flexible cord and sockets and all fixtures, on a guarantee of a minimum monthly bill of $1.00 for a period of one year, any outlets over 6 being paid for by the customer. The results after a year's experience were very gratifying. The rental of fans in one place at the rate of $1.00 a month brought in a large business, and it has been found that this sum during the season is more than ample to pay the interest and depreciation charges as well as meet repairs. The Knoxville, Tenn., plant furnishes to every employee of the company an information card and a prize is offered every few months to the man who brings in information of the most value to the

company. This card is in the form of a postal, the object being to mail a card as soon as the information is obtained, since notes made in memorandum books or on slips put in the pocket are frequently lost. Whether an employee is a meter reader or a lineman, if he has any information that will result in the company's securing or retaining business he makes note of the same and mails the card at once. Another practice which has brought in very good results has been enlisting the aid of school children, which has been done in Birmingham, Ala. It is advertised that for every customer brought on the company's line by the aid of a school child, $1.00 will be paid the child, or will be deposited to its credit in a savings bank. The company issues a weekly bulletin which is distributed by being placed in pockets in the street cars, and each week this contains a roll of honor, giving the names of children who had brought in customers. In addition to the payment of $1.00, at the end of a certain period the additional sum of $300 is distributed among those who have brought in the largest amount of business.

Organization and Conduct of a New Business Department Suitable for Central Stations in Cities of 50,000 Population and Under.

By J. M. Robb.

"Success lies in never tiring of doing, in repeating and never ceasing to repeat; in toiling, in waiting, in bearing and observing; in watching and experimenting, in falling back on oneself by reflection, turning the thought over and over, round and about the mind and vision, acting again and again upon it—this is the law of growth. The secret is to do, to do it now; not to look away at all."

Bishop Spalding's definition of success fits the organization and conduct of a new business department as though he had it especially in mind when he penned these lines. The ability to increase the sales of electricity must be as assiduously cultivated as you study the means of reducing costs and bettering your service, and there is no central station so small that it can afford to get along without a new business department.

There is a general tendency to believe that others accomplish their work with less effort than ourselves, and this perhaps is responsible for the lack of confidence some central station men have in their own ability to conduct a successful new business department.

The busiest manager or superintendent, if he will persistently devote a few minutes each day to increasing his sales will accomplish results as amazing as they are gratifying when he reviews them. Do not let anything prevent your beginning your new business campaign at once. Start now. Don't wait for printed forms or to think out definitely how you will go about it. When you have made your beginning you will be astonished at the opportunities for new business that will develop in the most unexpected places.

Working a new business department is like popping corn. Your first efforts produce only a cracking sound, but no popped corn. If you stop now, your work is lost. But keep on; first one kernel pops and then another and another. Encouraged by these, more and more kernals pop until your popper fills as if by magic. If, most fortunately for you, your business seems to be in the condition of the full popper, remember the unpopped kernels that are always found when the popper is emptied.

There are plenty of unpopped kernels of undeveloped electrical business in your territory which a little attention would convert into profitable income.

Naturally your first thought will be "How much money shall I spend to secure more business?" As the limit up to which money can be profitably spent for this purpose, is in all probability beyond your means, your chief concern will be to use to the best advantage the largest appropriation you can get. Go slowly at the beginning. As a general rule, any expenditure for pushing your business will be beneficial, but there are great possibilities for waste. Hence the necessity for waiting, observing, watching and experimenting.

How shall you spend your new business appropriation? For solicitors? For newspaper advertising? Or for "Direct-by-mail" advertising?

The most efficient results will be obtained by a combination of all these methods; newspaper advertising to awaken your public to the possibilities of electric service, make your customers realize your appreciation that your business is governed to the largest possible extent by the same principles applying to any retail selling business, and to prepare the way for your solicitors; solicitors to call upon your possible customers, answer their questions, argue away their objections and clinch their orders, as well as to investigate the troubles of your present customers; explain your methods of handling their business, and convince them that they are actually receiving full value for the money they are paying you.

And, finally, direct-by-mail advertising, to excite the interest of those possible users of your service your solicitor cannot readily reach; to back up his arguments with those he does see, and to keep alive his prospective customer's interest between his calls.

Each of the above divisions of business getting, properly handled, will produce excellent results, but the most effective work can only be done with a combination of all three.

Endeavor to handle your new business appropriation so that your efforts will be continuous. If you must choose one of the three methods above outlined, by all means employ a solicitor and make strenuous efforts to keep him permanently at the work.

SOLICITORS.

In picking your solicitors, pay the most attention to their ability to handle people.

For this work you must have salesmen, and no man who cannot handle people can ever be a salesman.

The gift of gab is not an essential, but the ability to talk convincingly is. Many a loquacious salesman spoils his work by talking too much.

Beware of the brilliant, sharp man, who works by fits and starts.

Dependability is of the utmost importance. The slow plodder, who never forgets a point once mastered, will soon distance the speedy man who quickly catches on, but just as quickly tires if his first efforts are not successful.

Persistency counts for more than dash. Few prospects are interested at the first call, and just as water constantly dropping wears away stones, so patient solicitation secures profitable business.

If you have, among your employes, a man who evidences selling ability, use him for a solicitor.

Your solicitor must, of course, thoroughly understand your business, but this does not mean that he must start with a working knowledge. If your man is a real salesman, he may be ignorant of the electric business at the start. A few days coaching will fit him to begin your work and every day after will add to his knowledge. Some gas companies have made solicitors of their regular employes in connection with their routine work, by paying them commissions on new business secured, with the understanding that the new business work would be pushed only outside of regular working hours.

Properly handled this practice will produce results and it possesses the additional advantage of arousing the men's interest in pushing your business.

There is always danger, however, that the prospect of a commission will lead to neglect of some regular duty, and the practice is further likely to cause jealousy among the men.

An excellent way to pick solicitors is to advertise for salesmen and carefully study the applicants. You can soon pick out the effective men. The man who can't be earnest in advancing his own interests certainly won't make much headway in pushing yours.

In searching for soliciting material, do not neglect to consider how a woman can push your interests, if you can find one of the right sort.

*Paper which, upon recommendation of a Committee of the National Electric Light Association, was awarded the third prize ($200) in a competition instituted by the Co-operative Electrical Development Association.

Having picked your solicitors, take time enough to thoroughly explain your business policy to them. Discuss with them your rates, your contracts, your customs, and your rules and regulations. Make clear to them the distinction between profitable and unprofitable business. Teach them to think in dollars and cents and give them enough data to enable them to estimate the cost of connecting any business they secure.

Take them over your plant and endeavor to make them appreciate the amount of work involved in rendering good service to your customers.

If possible, make a few calls with each solicitor, letting him do all the talking and then coach him between calls.

If you already have one or more solicitors, they can assist you in training the new men, but it will be to your best interest to let the beginners receive their first notions of your methods of handling your customers from yourself.

Divide your territory into as many districts as you have solicitors, arranging as nearly as possible an equal division of business and residence territory in each district, so as to give each man an equal amount of possible business.

The size of your new business appropriation will determine the number of solicitors you can use. Some companies have profitably worked one solicitor to each 4,000 of population. Each central station man must determine the number of solicitors to employ from his own conditions.

Your solicitors are now ready to go after business, but your work in handling them has just begun.

It depends on you to arouse their enthusiasm to the highest pitch and keep it there.

Have the solicitors report to you each morning as early as

1

Name _____ SOLICITORS DAILY REPORT For Date _____

Customer's Name & Address	Con. No.	Lighting No. 10's	Lighting No. Arcs	Power H.P.	Signs 16's	Appliances	Total Load	Cost to Connect	Est Yrly Revenue	Cash Paid
						Total Cash Rec'd by				
Total for this Day										
Total Week up to this Day										
Total Mo. to 1st Day of Week										
Total Year to 1st Day of Mo.										
Total Year to Date Inc.										

Electric Company

FORM NO. I.

convenient and canvass their previous day's work. Have a little booster meeting to start the day. Have each man tell of the orders he secured yesterday, the prospects he developed, and anything which helped him secure an order.

Encourage the men to discuss the business freely and to advance their criticisms and suggestions.

Be liberal in your commendations of good work and sparing of criticism, but criticise sharply when circumstances require it.

As often as possible explain the operation of some appliance you are pushing. Demonstrate its good points and teach the men the arguments to down any objection that could be advanced by a prospective customer.

Use every means at your disposal to increase the men's knowledge of your business, constantly impressing upon them that any increase in their efficiency is to your mutual advantage. Note carefully any articles in trade papers, etc., or any articles on salesmanship that will help your men and specifically call their attention to them, asking the men to read them carefully and then tell you what they think of the matters discussed.

Have your men phone to you at noon, both to let them know that you are following their work and to advise them of any prospects which may have developed in their respective territory since morning.

Keep a blackboard record of each man's work brought up to date, to advertise to all the employes the work the solicitors are securing.

Have each solicitor turn in a daily report each morning, similar to Form No. 1, given herewith.

If any payments are collected, the amounts must be properly entered, footed and receipted by your cashier, or whoever is authorized to receive the cash.

The daily, weekly, monthly and yearly totals make possible an immediate comparison of each man's work, both with reference to current results and to results obtained in any previous period.

This form should be printed on sheets in letter-head size and put up in pads. The completed sheets should then be filed in a vertical file, where they give a complete record of each man's work.

You must train your solicitors to be old business retainers as well as new business getters.

They must realize that their own, the customer's, and the company's interests are all bound together.

Turn over to them for investigation the complaints of customers in their territory.

Have them look up the customer's apparatus, reread his meter, explain to him the methods used in handling his business and make a vigorous effort to convince the customer that he has the same check on his purchases of electricity that he has on his purchases of any other commodity.

Energy expended to convince customers that they are receiving full value for the money they pay you is one of the most profitable means of securing more business. If your customers are made to realize that they are receiving their money's worth in service rendered, they will use your service much more liberally and be much more open to your suggestions for their use of more conveniences requiring additional current.

It is a mistake to pay solicitors solely commissions on the sales of appliances. This practice will surely result in sales of appliances to customers who cannot advantageously use them and will certainly cause much dissatisfaction and loss to you.

A flat salary is preferable and some managers adopt the flat salary method because of the labor required to record the results of each solicitor's work.

The ideal method is a combination of a flat salary and a commission based upon the volume and value to the company of the sales of electricity effected by the solicitor, with a fine for business loss in the territory allotted to him.

One prominent gas company pays its solicitors a salary of $50 per month and a commission based on results secured, which is determined as follows:

A pool is made each month, representing a certain sum for each solicitor employed.

The various kinds of business to be secured are classified and given an arbitrary value of a certain number of points. The greatest number of points is assigned to business requiring no additional investment to serve and to business corresponding to sign and power business.

From this the business is graded down to the lowest number of points for business which is simply renewal business, due to consumers removing from one location to another, and business requiring a heavy investment for a relatively small income.

To assist in the classification, the solicitor must report on a card the estimated cost of connecting the customer, as determined from a schedule furnished him in which are given the costs, as determined by the previous years' averages, of the various items entering into the total investment necessary to serve the new business.

He must also report an estimate of the first year's revenue from the new customer.

The ratio between cost of connecting and volume of sales is considered by the new business department manager in assigning the number of points to the business secured.

At regular intervals the solicitor's records are checked from the customers' ledgers, so that the tendency to overestimate the value of secured business may be offset.

A deduction of an arbitrary number of points is made for business lost in each solicitor's territory.

At the end of each month each solicitor's points are totaled

and the percentage his total bears to the total of all the solicitors' points determines his share of the pool.

In this particular case the sum pooled for each solicitor is $25, making the average salary $75 per month per man. Some of the solicitors on this basis earn as much as $125 per month.

A better way is to determine what price you can pay for each kilowatt of new business secured, grading this price from a high rate for profitable business to a very low rate for business requiring a heavy investment, and no rate for unprofitable business.

Then agree to pay the solicitors a commission at these rates for a year for all business secured, having it understood that any business lost in their territory shall be deducted from the commissions at the same rates.

Such an arrangement is mutually profitable for both solicitor and company.

The business secured can be readily determined if the backs of the Possible Business Index sheets be printed as shown on form "A."

The solicitor should be required to turn in with each order the corresponding P.B.I. sheet on which he has noted what his order covers.

If the order represents a customer already connected the amount of the customer's business for the year previous to securing the order should be entered on the P.B.I. sheet and also the monthly average for the year.

The sheet should then be filed in a secured business binder under the name of the solicitor securing the business.

Each month for the year following the date of the order, the

A

REPORT OF SECURED BUSINESS

No. St. Name Solicitor

Date Order Secured For

Est. Cost to Connect Est. Yearly Revenue

Revenue for Year Previous to Order Kw. Hrs. Amt.

Revenue since Order

	Kw. Hrs.	Amount	Remarks
January			
February			
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			
Total Year			
Previous Year			
Increase			

Meter Removed Cause

Electric Company

FORM "A."

amount of the customer's business should be posted to the sheets and the increased business credited to the solicitor at the agreed rate. Such an arrangement may be kept up with a minimum of work and may be modified to suit any set of conditions.

It would induce the solicitors to devote their efforts along channels most profitable to the company, and the deduction for business lost would insure their being old business retainers as well as new business getters.

Under such an arrangement the solicitor would have every inducement to make every effort to remedy complaints and he would find it very unprofitable to waste his time selling appliances to customers who could not use them to their best advantage.

If the foregoing seems too complicated a method of handling solicitors, you would do well to reflect that the success of your new business department demands good men to carry on the work. You can secure the best work from good men only when you pay them in proportion to the results they secure for you.

Any plan which will increase the efficiency of your men in securing more business for you, is mutually profitable to every one concerned.

POSSIBLE BUSINESS INDEX.

One of the most necessary essentials of a systematic campaign for new business is a Possible Business Index.

Pope says:

"Index learning turns no student pale,
But it grasps the eel of science by the tail."

That expresses the aim of a Possible Business Index. It is to the conduct of a new business department what plans and specifications are to a piece of construction work. No two men will work up their new business data precisely alike. Where one will want a complete plan, setting forth every detail, another will be content with a free hand pencil sketch with a very few notes.

It is well to bear in mind that when a man goes hunting he must have a pretty definite idea of what he seeks. If you have

2 POSSIBLE BUSINESS INDEX No Meter Set

Name No. Service in ? St.

Owner No. Floors No. Rooms Used For

How Lighted Is B'l'd'g. Wired Fixtures Hung

Has Current been Used Why Cut Off

How Heated Apparatus in Laundry

Kitchen Fuel

Phone No. Data File No.

Solicitor	Date	Remarks	MAIL ADV'TG. No.	MAIL ADV'TG. Date

Electric Company

FORM "2."

in your new business campaign a complete index of the possibilities in your territory, you will waste less of your new business appropriation.

While cards are generally used for such an index, loose sheets 5 x 8 inch in size and bound in binders will be found to be far more useful, and, in addition, will give all of the advantages of a card index.

Some of the advantages over cards are as follows:

The sheets are larger, giving more space for useful data.

The sheets bound in the binders will always be found in their proper sequence, and, if necessary, can be removed from the binder as easily as a card from a file.

By using thin paper, much more information can be filed in a given space.

By using a thin binder, it may be carried in the pocket and in this manner the sheets are much easier to handle in the field than cards.

Forms 2 and 3 and "A" give a set of form for a Possible Business Index. Form "A" is to be printed on the reverse sides of forms 2 and 3. These forms are self-explanatory. The 'phone number is put in because often very effective advertising soliciting can be done by 'phone. The data file number is to be used when correspondence or estimates, etc., accumulate in soliciting a prospect.

An envelope, large enough to contain all of the letters, esti-

3 POSSIBLE BUSINESS INDEX Meter Set

Name No. St.

Owner No. Floors Rooms Used for

How Lighted Is Bldg. Wired Fixtures Hung

Size Meter Current Apparatus

How Heated Kitchen Fuel Laundry App.

Phone No. Data File No.

Solicitor	Date	Remarks	MAIL ADV'TG. No.	MAIL ADV'TG. Date

Electric Company

FORM "3."

mates, etc., in flat sheets, is used, given a number and filed in your data files. The envelope number posted to the Index sheet gives quick reference to all of the data on file for the prospect.

Your Possible Business Index should contain a sheet for each house or prospect in your territory.

As your territory is extended, put in a sheet for each house or prospect in the new territory.

Arrange your orders so that every meter set, remove or transfer order and every appliance order, will go to the person in charge of the Possible Business Index, so that it will be always up to date, and show a complete list of all electrical appliances you are supplying with current.

Remember that your Index is your guide for directing your fight for more business, and the more careful attention it receives the less effort you will waste.

Use different colors of paper to indicate the different classes of new business.

For instance, white paper to indicate a building where no electricity has ever been sold.

Yellow paper to indicate a building now being supplied with current. Make the sheet for this class of business show an itemized statement of the connected load.

Red paper for a building where current has been supplied, but, for some reason, has been disconnected.

Brown paper to indicate power prospects.

Green paper to indicate sign prospects.

Properly laid out and handled, the Possible Business Index will not only show the possibilities for business, but it will also show the amount of work done on each prospect, and when the business is finally secured the index sheets can be used to keep a record of the business obtained by each solicitor. This is easily accomplished by noting on the sheets the orders to be credited to the solicitors and then filing them in a separate binder behind the name of the solicitor who is entitled to credit.

Then, periodically, the revenue from such business can be posted to the sheets credited to each solicitor and his income earning value is thus readily determined.

One of the best methods of starting your solicitors is to have them first go over their territory to make up reports for the Possible Business Index. In this manner the ice is more easily broken for a new man and he quickly becomes familiar with his territory.

Periodically, at regular intervals, depending upon your local conditions, have your man check up the New Business Index and carefully make the necessary corrections.

If you are mailing matter to your prospects, this practice will not only save money in postage, but the moral effect upon your prospects will increase the efficiency of your new business department many per cent.

To assist in keeping your Possible Business Index up to date, give your solicitors credit for any business closed in your office, where the Index shows the solicitor has called on the customer within thirty days of the date of the order.

NEWSPAPER ADVERTISING.

Your new business department can be made to prosper without the aid of your newspapers, but, if you are wise and your appropriation permits, you will use them liberally and continuously.

Properly used, the newspaper will aid you in molding a favorable public opinion and it will also secure new business for you. If it does nothing else, it will pay its cost in the increased efficiency it will produce in your solicitor's work. The newspaper adds a dignity to the house-to-house work, of your men, which it would otherwise lack.

Use as much space as your appropriation will buy, but use it continuously. Don't splurge, unless your appropriation will stand it. Consider, also, how the average person scans his newspaper and you will realize that if you would have your advertisements noticed, they must be arranged so that "he who runs may read."

This means that your newspaper talks must be very, very short, sharp, pithy, incise. They must stand out so that upon the paper being opened the advertisement at once catches the eyes. Plenty of white space must be used to accomplish this.

The following excellent suggestion is taken from the Electrical World and Engineer of March 25, 1905:

"In preparing copy for newspaper advertisements, the central station man must bear in mind that his efforts will not be searched for, except by himself. Neither can he, as a rule, use sufficient space that his ads will demand attention merely on account of their size. His problem, therefore, is to devise a means of insuring that his announcements will be read without resorting to anything bizarre or in bad taste.

"The plan here suggested has proved very successful, and anyone who adopts it will find that his advertisements will be the most prominent things on the pages which they adorn.

"It consists essentially of the purchase of a few fonts of a large legible type to be used for your own announcements exclusively and differing from anything in regular use by the paper in which they appear. The type in which the advertisement here reproduced (but reduced to about 16 points) is set, is known as 28-point Caslon Old Style and has the reputation of being the most legible face ever cut. It can be used to advantage in two ways—first, as in the example given, in a few lines well spaced and surrounded by plenty of white space, and, second, in two or three lines well spaced, as before, and followed by matter in small type. While Caslon Old Style is probably the best type for this purpose, there are other plain, bold and legible faces which can be used if the Caslon is pre-empted, though, as a matter of course, the results will not be so good if others are already using the same idea. When there is no competition in the lighting business, it is just as well in this style of announcement to omit all reference to name and address. It is 'different' and that in itself is good advertising. The following are offered as suggestions for 'copy.' Some of them are original, others have been culled from various sources.

"In papers of ordinary get-up as to their advertisements, it is surprising how impossible it is to look at a page containing one such as I have described, without seeing it first, almost to the exclusion of everything else. Two fonts of type costing about $8 will set any of the advertisements which can be set in the space commonly used."

In connection with the above, note the Macbeth lamp chimney ads running in the magazines.

Give your newspaper talks direction. Select some person or prospect in your city, as nearly typical as possible, of the prevailing type of people whose business you are going to get and address all your talks to him. It has been demonstrated in training street car conductors to call streets and stopping places that announcements are much more easily understood if the conductor will direct his talk to some individual in the car, instead of just talking into space.

The same thing holds good in advertising.

You are going to persuade people to buy your service.

Very well. Point your arguments for some particular individual. Be direct, come to the point at once.

Use old fashioned plain English, the kind that says "Keep Out" instead of "No Admittance," or "Come In," instead of "Visitors are Welcome."

Use common sense. "The man who has the truth in his heart need never fear the lack of persuasion on his lips."

It isn't necessary that you be able to write flowing sentences.

You have a story to tell. Imagine that you have your prospect up in a corner where he can't get away. Talk to him, but be brief.

Select some phrase to correspond with "Cook with Gas." Use it to head every advertisement and follow it with a reason why.

Here are some suggestions.

LET ELECTRICITY DO YOUR WORK.

Get an electric iron. Then your ironing will be done with half the time and work. One will be sent to you on thirty days' trial if you 'phone to No. ———.

Get an electric warmer for baby's food. Then you won't have to chase down stairs nights to the gas stove.

Put up a porch lamp, with the street number on the globe, keep it lighted evenings. Let your friends know where you live when they call.

How about the wear and tear that clothes wringer takes out of your clothes? An electric centrifugal clothes-wringer will save it.

Ever hunt for things in your closets with matches? Electric closet lamps are cheap fire insurance. Put them in now.

Do you use a chafing dish? See the electric chafing dishes at (your address).

Does your wife sew?

She certainly will appreciate an electric motor to drive her machine. Order one on trial.

Do you use power?

An electic motor will furnish it at less expense than anything else you can get. Telephone No. —— for particulars.

An electric fan will chase the flies out for you. Send in your order now.

Change your copy every day. This is important and it will lead many people to look up your ads to see what you will say next.

The more people whom you can get to think about your business, the faster it will increase.

Keep a scrap book file containing copies of every advertisement you run. If you will arrange your scrap book in the order in which your ads. appear, it will form an excellent means of checking your monthly newspaper bills.

Study every ad. that comes to your notice, in your endeavor to make your own ads different from the others with which it is printed. The effort will pay big returns.

DIRECT-BY-MAIL ADVERTISING.

A campaign of direct advertising by mail will still further increase your solicitors' efficiency. Mail will easily reach customers who will never see a solicitor, or get to them at times when a solicitor's call would be considered an intrusion and resented.

Be chary, however, of your use of circular letters and do not place too much faith in the selling power of multi-colored direct-by-mail stuff, artistically folded like a table cloth or bedsheet.

Business men to-day are busy. A sentence in black type on a plain postal will make an indelible unconscious impression, where a choice collection of pictures on a square yard of wrapping paper will only produce an emphatic cuss word and a vigorous shove toward the waste basket.

The chief value of a circular letter is its personal appeal. Therefore is the necessity for its preparation with consummate care to give it all the effect of a personal appeal to the reader.

Most circular letters are an abomination and unless you are sure of your ability to convince your man that it is his interest and business, not yours, that you are pushing, you would better stick to your postals.

If you do send out circular letters, enclose with each one an addressed postal (not a mailing card without a stamp), so that when your letter makes the desired impression, the postal will be mailed before your prospect changes his mind in hunting for a one-cent stamp.

Be sure, too, that the postals are numbered for identification, for sometimes prospects mail cards, forgetting to sign them.

If you have an addressing machine, have the addresses of your prospective customers set up for it and arrange to keep it up to date. This will put you in position to effectively and quickly reach your prospects with any proposition you want to push.

Number consecutively the printed matter, mailing cards, circular letters, etc., that you sent out; keep a scrap book with copies of all such matter and have the date and number stamped upon your Possible Business Index sheets. By tabulating the orders secured from each lot of matter mailed out, as shown by the entries on the Possible Business Index, you are in position to judge the effectiveness of what you are distributing.

CO-OPERATION WITH EMPLOYES.

Do not end your work among your own men with training your solicitors. Work up the interest of every man connected with the company. Make them all see the possibilities that can be obtained if every man makes use of the opportunities for boosting the company's business that comes to him every day.

Organize a progress club among the men, with meetings to be held monthly, or oftener, at which matters relating to the service, the sales of appliances, their use, the betterment of the service, etc., can be discussed. Invite their criticisms and study their suggestions. This work will cost much in time and energy, but better results will be secured than can be obtained in any other manner.

SALESROOM.

Your salesroom is a most important adjunct of your new business department.

First impressions count for everything with some people and for something with everybody. Your conditions will govern the quantity of apparatus you can display, but even if you show only a flat iron, you can show it, if you will, so that it will attract interested attention.

Don't neglect to have a glass case watt-hour meter connected up, so that you can demonstrate its operation at any time.

Make use of the pamphlets, etc., that manufacturers of electrical apparatus will supply you for the asking. Everything helps.

CATALOGUES.

Keep carefully filed, for references, every catalogue of current-using apparatus you can obtain. Study your catalogues and have your solicitor study them. They will suggest endless applications demanding the use of current, many of which can be profitably used by your consumers.

APPLIANCE POLICY.

Make your selling prices for appliances bring you the same rate of profit a dealer would expect, but scrupulously put into advertising or soliciting every cent of such profit. This practice will encourage dealers to handle electrical appliances. Co-operation is what you need and the more people in your territory who can be induced to push electrical appliances, the better will it be for you. The practice of selling appliances at cost or less than cost, further, has the tendency to confirm the popular opinion of the profits from the sale of electricity. Then, too, many people measure the value of an article by its price and emphasizing the low price of what you are selling is apt to depreciate it to them.

Selling electrical appliances is more a matter of salesmanship than price.

Convince your customers of the value of your service. Create in them a desire to use it. It can be done by persistent work. Make your terms easy; small payments on long time and they will buy.

Offer every appliance you handle on trial long enough to thoroughly demonstrate its convenience and utility.

Follow up every appliance sold with a careful inspection, to ascertain that it has been properly set and that its operation is thoroughly understood.

Push forward the merits of your service and leave price the last thing to discuss when you have shown how desirable and useful a thing your service is.

In exceptional cases, your margin of profit will permit you to arrange exchanges to secure profitable business you could not otherwise get, because of the customer's investment in non-current consuming apparatus.

CO-OPERATION WITH CONTRACTORS.

Display in a prominent place in your office a wall directory of all the electric contractors in your territory.

Arrange to send them immediately any tips coming to your notice concerning wire work, etc.

Keep in touch with your contractors, establish friendly relations with them and consider their criticisms and also their suggestions.

Their co-operation is a valuable means of extending your business and is well worth your strenuous efforts to secure and hold.

Keep informed of the local work your architects have in hand and arrange for regular reports from the building inspector's office.

Knowing in advance of projected new buildings or remodelling work, you can furnish advance information to your friends, the contractors, and their self-interest in securing the work will make them efficient solicitors for you.

PUBLICITY.

Make use of every legimate means of securing desirable publicity for your company.

Establish friendly relations with the editors and reporters of your newspapers.

In most small towns, news items are not plentiful and much profitable publicity can be secured through tactfully acquainting your newspaper man of current happenings, such as contracts closed, contemplated improvements, etc., or handing them an

occasional clipping describing some electrical appliance or some new application of electricity.

Should you, unfortunately, have an accident, prepare your own version for your papers. It will save them the trouble of writing it up and insure that the public hears the story as you want it told.

Remember your business is bound to receive a certain amount of attention from the press. If you will make the effort, you can direct it to your advantage.

Make every piece of company property carry its advertising message. If there is no ordinance prohibiting it, put a permanent enameled sign on every one of your poles. You need not incur the expense of equipping all the poles at one time, but by buying permanent signs you can put them up on the installment plan, without finding the expense too heavy a burden.

The benefit to be obtained by circulating a monthly bulletin among their customers and prospective customers is not properly appreciated by central station men.

Most electric men fully realize the benefits their companies bring to the community they serve, but too many forget that there is no one except themselves to exploit these benefits to obtain the public appreciation they merit. Electric men, and gas men, too, for that matter, have too long been guilty of "hiding their light under a bushel."

Energetically pushing forward the many advantages of electric service, both to the customers and to the community as a whole, will do more than anything else to disarm the hostile spirit too often manifested against central stations.

There is no one to do this save the central station men themselves, and no better way to accomplish it than the monthly bulletin.

The practice of advertising appliances on or with monthly bills for service is of doubtful value. The recipient of the bill is then in the least receptive mood for suggestions to increase his use of current.

The bulletin method is more costly to be sure, but it deserves careful consideration among your other plans for extending your business.

Give your wagons, tool carts, etc., especial attention. Paint them often and keep them clean.

Make your entire equipment carry its message of wide-awakeness and progressiveness to your community.

CULTIVATING POPULARITY.

Aim to be considered in your community as a public benefactor.

Use a portion of your new business appropriation for purchasing advertising space in programs for church entertainments, etc.

The space so purchased has little advertising value, but when the character and energy of the people behind the church and charitable organizations is considered, the importance of securing their good will is apparent.

The amount paid in each case need only be a small one, but it is important that this matter be so handled as to build up a co-operative spirit and that your customers appreciate that you are anxious to lend your assistance to anything promoting the public welfare.

In this line of work, beware of the professional advertising scheme promoters.

If possible, arrange to loan cooking and other apparatus to church and charitable organizations free of charge, including electricity used. Stipulate, however, that a representative of your company shall superintend its operation to demonstrate the apparatus and to make use of any opportunity to promote your interests that may occur.

Your efforts along this line of work will certainly go far towards establishing your company solidly in the good graces of your customers and possible customers.

Never let any adverse criticism of your company, by any individual in your community, go unanswered.

Public service companies have so generally neglected to answer hostile criticisms that the public generally has come to consider that they have no answer.

Whenever you hear of a disgruntled individual, ascertain as quickly as possible what his grievance is, and either show him where he is wrong, or right his trouble. A few people you will find whom you cannot convince, but your efforts in this direction, persistently followed up, will bear rich fruit.

CONCLUSIONS.

You have doubtless noticed that there is nothing new or radical in what has been advanced in this paper for the organization and conduct of a new business department.

These things have all occurred to every man who has given persistent thought to the work and will occur anew to the men who will engage in it later.

It would perhaps be difficult for any one man to follow all of the lines suggested, but every man doing central station work can, if he will, start with some one line of effort in this direction.

The start is the all-important thing, for if the work be followed up, new ways and methods will be constantly suggested to the persistent worker.

Thoreau says: "I learned this—that if one advances confidently in the direction of his dreams he will meet with a success unexpected in common. If you have built castles in the air, your work need not be lost; that is where they should be—now put the foundations under them."

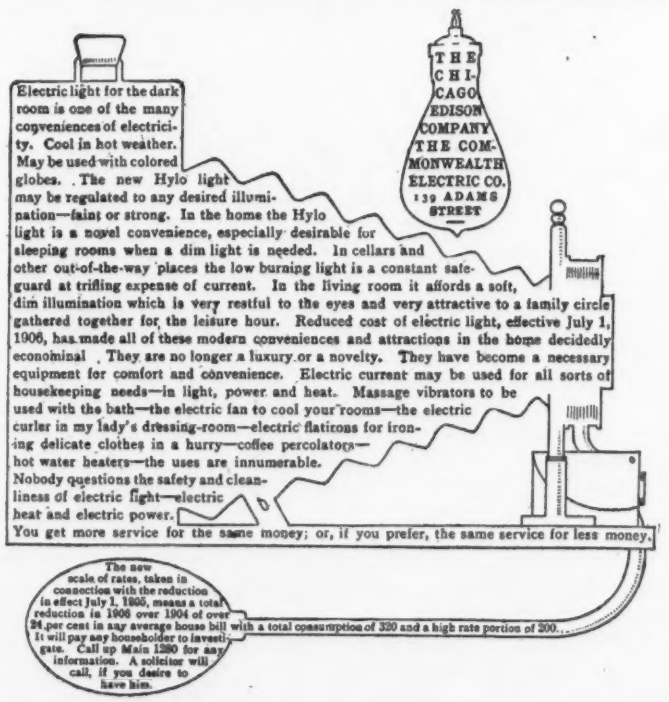
This also applies to the new business work.

Dream your dreams of satisfied customers lighting their homes, their factories and their stores with your current, driving their machines with your power; cooking their meals with your appliances; advertising their business with your signs. Then work, work day and night to make your dreams come true.

Work; everlasting, never-tiring, patient, persistent work, that is the secret of a successful new business department.

A Chicago Advertisement.

The Chicago central station companies are occupying regularly each day considerable space in all the best Chicago dailies. One advertisement which is especially striking is reproduced here.


THE CHICAGO EDISON COMPANY
THE COMMONWEALTH ELECTRIC CO.
139 ADAMS STREET
Electric light for the dark room is one of the many conveniences of electricity. Cool in hot weather. May be used with colored globes. The new Hylo light may be regulated to any desired illumination—faint or strong. In the home the Hylo light is a novel convenience, especially desirable for sleeping rooms when a dim light is needed. In cellars and other out-of-the-way places the low burning light is a constant safeguard at trifling expense of current. In the living room it affords a soft, dim illumination which is very restful to the eyes and very attractive to a family circle gathered together for the leisure hour. Reduced cost of electric light, effective July 1, 1906, has made all of these modern conveniences and attractions in the home decidedly economical. They are no longer a luxury or a novelty. They have become a necessary equipment for comfort and convenience. Electric current may be used for all sorts of housekeeping needs—in light, power and heat. Massage vibrators to be used with the bath—the electric fan to cool your rooms—the electric curler in my lady's dressing-room—electric flatirons for ironing delicate clothes in a hurry—coffee percolators—hot water heaters—the uses are innumerable. Nobody questions the safety and cleanliness of electric light—electric heat and electric power.
You get more service for the same money; or, if you prefer, the same service for less money.
The new scale of rates, taken in connection with the reduction in effect July 1, 1905, means a total reduction in 1906 over 1904 of over 24 per cent in any average house bill with a total consumption of 320 and a high rate portion of 200. It will pay any householder to investigate. Call up Main 1280 for any information. A solicitor will call, if you desire to have him.

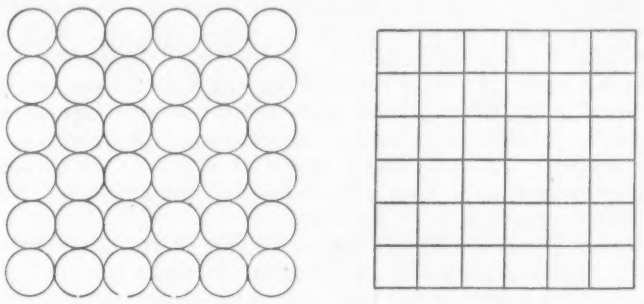
While the application of the turn-down lamp to dark rooms may not be directly a very great revenue producer, it is worth calling attention to and the novelty of the advertisement would attract the attention of anyone.

LETTER TO THE EDITORS.

Reducing the Wear on Motor Bearings.

To the Editors of Electrical World:

SIRS:—The writer sometime ago had a remarkable experience with an equipment of railway apparatus that was used to convey ore from a large group of mines. The apparatus was of modern type, but owing to hard usage and the overtaxed condition of the service, the bearings could not be made to last more than 90 days. They were made of a very high grade metal and received the best of lubricant; but to no avail. The writer, as a last resource, had one of the locomotives run over the pit and had the upper halves of the motor cases removed. The field coils were then removed and upon inspection it was found that the coils were wound with 135 turns of No. 2 B. & S. gauge round copper wire. The writer had new field coils wound with square copper wire of equal cross-sectional area and increased the number of turns from 135 to 148. It is a well-known fact that the percentage of copper in any given volume of winding space is approximately 78 per cent with round wire of this size, while a square wire of the same cross-sectional area will give a volume of copper of about 90 per cent without encroaching upon the limited space provided around the poles. It will readily be seen therefore that the upper poles having an increase of about 10 per cent in ampere-turns exerted a lifting action on the armature and acted as a counterbalance to the weight of the armature, tending to keep the armature centralized between the poles and reducee the frictional pressure on the bottom babbitts. After the change was made the locomotive was put back in service and subjected to less favorable conditions than the others to see what effect the change would have. Up to date it has been in constant service for over 14 months and the bearings are still in good condition. The motors have received less attention than any others in use on the road and the commutators are in a much better condition than were the others after a 30-day run. The writer has also tried the above expedient on several large series-wound motors on cranes and it has increased the life of the brasses materially. This expedient may be adopted on many motors to cut down the repairs on the commutators, bearings, etc.



COMPARATIVE AREAS OF ROUND AND SQUARE WIRE.

SPRECKLES, CAL. F. P. DEWILDE.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Circular Diagrams of Polyphase Induction Motors.—LOMBARDI.—A paper read before the Italian Electrical Association. The object of the investigation of the author was to verify by direct experiment the correctness of the circular diagrams of polyphase induction machines at all speeds below and above synchronism. He studied by means of careful measurements made with a three-phase induction machine of 9 kw the different constructions of the diagram given by Heyland, Heubach, Ossanna and Grob. A full agreement of his results with the theory was obtained only for the diagrams of Ossanna and Grob, and only in such cases in which the primary circuits had a considerable resistance. The linear scale of measuring the slip remains the same for all speeds so that the variation proposed by Heubach for speeds above synchronism is of no more value than the objections advanced by Mueller and Benischke. The electrical power consumed becomes zero only in two particular cases; first, when the speed is slightly superior to that of synchronism; second, for a speed which is not necessarily twice the speed of synchronism, as Heubach thought; it depends rather on the data of construction of the machine itself. The first part of the paper contains a historical review of the graphical methods and the experimental investigations carried out before. The second part gives a detailed description of the machine which was used by the author and of the methods of measurement which he employed, while the conclusion of the paper gives a comparison of the theoretical results with those of the experiments.—*Atti della Ass. Elettrot. Italiana,* Vol. 10, No. 1, 1906.

Lamps and Lighting.

Measuring the Mean Spherical and the Mean Hemispherical Candle Power.—MONASCH.—A very long paper giving a full account of an extended investigation of the use of the Ulbricht spherical photometer and some modifications of it. After brief remarks on the three lumenmeters of Blondel and the indicating photometer of Matthews, he discusses the use of a hollow sphere by Ulbricht; the internal surface of the sphere having received a diffusely reflecting paint and a small frosted window being inserted which serves as the source of light for the photometric measurements. The author thinks that the name of this instrument—"Spherical Photometer"—is not a happy one, since it serves only for providing a secondary source of light in the shape of the small frosted glass window for the real photometer. All photometers which give the mean spherical candle-power by a single measurement are called integrators. For comparing different lamps with respect to the transformation of electrical energy into light, the mean spherical candle-power is the decisive factor, but it is of less importance for the illuminating engineer, who may want to light, for instance, a street. An error is often committed in that if the mean spherical candle-power of a lamp is 400 cp, the "mean spherical candle-power of two such lamps" (which mostly are suspended at a distance of 30 to 50 meters from each other) is assumed to be 800 cp. This

FIG. 1.—MEASURING CANDLE-POWER.

error is often made in comparing combinations of two lamps or of three lamps in series. For many lamps the mean spherical candle-power is not equivalent to the useful candle-power. For street lighting the useful candle-power is identical with the mean lower hemispherical candle-power. Bloch has shown that the mean hemispherical candle-power may also be measured by means of the spherical photometer, and both Ulbricht and Bloch have shown that this spherical photometer may also be used for determining with a single measurement the mean spherical candle-power of lamps for which the distribution of the light is not symmetrical around their axle. For building large spheres the author recommends the use of a wire frame, coated with sheet metal. There is some difficulty involved in getting a durable paint for the interior surface. Lithopone is very good, but

it needs a binding material. If water is used as binding material, the paint does not stick. The best binding material found by the author is "zapon" lacquer, which with lithopone sticks to metal as well as glass. Since a large sphere, such as of two meters diameter, as recommended by Ulbricht, is not easy to handle, the present author tried to find out whether it could not be replaced by a hemisphere such as illustrated in Fig. 1, the diameter being also two meters and the lid painted on the inside with the same kind of white paint. Concerning the results of the extended tests of the author, reference must be made to the original paper. Some of his more important conclusions are as follows: The choice of the place where the little frosted observation window is inserted in the surface of the sphere is of no account. It should be so chosen as to afford the greatest convenience for the man who makes the measurements. Any eccentric arrangement of the source of light within this sphere does not change the illumination of the little observation window. It is necessary to recalibrate the sphere for each type of lamp, even with a sphere of two meters diameter, if the source of light is suspended deeper than 10 cm. below the top of the sphere, or when the lamp has exterior reflectors. The closed hemisphere of the author behaves like Ulbricht's sphere with respect to the independence of the indirect illumination of the observation window from the position of the lamp within. As a matter of fact it seems that any geometrical form of integrator is just as suitable as the sphere or hemisphere for photometric tests if the total flux of light emitted by the lamp can be completely included within the hollow body, the internal surface of which is perfect with respect to diffused reflection. The hemisphere has many practical advantages over the sphere. It is cheaper and can be more easily handled. The paper concludes with an account of measurements, giving diagrams of photometric tests of arc lamps with vertical, inclined carbons, the distribution of light being unsymmetrical around their vertical axle.—*Elek. Zeit.*, July 19 and 26.

Power.

Electric Winding in Mines.—Orban.—A discussion of the systems in use in practice for electric driving of winding engines, with special reference to a new system employed at the Hasard Collieries in Belgium. Five different combinations are reviewed. In the first the fly-wheel is mounted on the shaft of the engine, driving the generator, which is for continuous current, no motor-generator being used. This system, although of great simplicity, has the disadvantage that a perfect equalization cannot be obtained as the power developed by the steam engine necessarily falls off when the speed is reduced. In each of the next two systems a fly-wheel is used on the shaft of a motor-generator set driven either by a continuous-current or an alternating-current motor and depending on some form of automatic regulator for keeping the power input to the set constant. Examples of this arrangement are found in the Siemens-Schuckert installations at the Zollern II mine at Gelsenkirchen; the system is also used by the firm of Lahmayer and others, although the methods of automatic control vary somewhat in the different systems. In the fourth arrangement the equalizer set consists of a single continuous-current machine provided with a heavy fly-wheel connected in parallel with the main generator and acting either as motor or generator, according as the demand for power is less or greater than the normal output of the main generator, and the winding motor is connected directly to the main generator terminals. In this case it is usually necessary to employ an auxiliary booster in series with the winding motor to obviate the heavy variations of voltage that would be produced. This extra machine is mounted on the same shaft as the equalizer. The last system, due to Leon Creplet, is that used in the Hasard Collieries, and is a series system. The use of two auxiliary machines is avoided by connecting the fly-wheel equalizer in series with the winding motor. Where a continuous-current supply is available, no further machines are required, but on three-phase systems, such as that in use at the Hasard Collieries, a motor-generator to transform to continuous current is needed as well as the fly-wheel machine and the winding motor. Reversal of the direction of motion of the winding motor is effected by reversing the circuit in its armature, but care has to be taken that the main circuit is not interrupted, so its terminals are short-circuited while the connections are being reversed. As the armature current depends in a series system such as this on considerations of the generator and not the motor, all regulation of torque is done by variation of the strength of the motor field, which is likewise short-circuited when the winding motor is at rest or is desired to run light without either driving or electric braking effect. The speed regulation is obtained by variation of the voltage of the terminals of the motor. Suppose it is fully excited, its speed of rotation will be sensibly proportional to the applied voltage. This is, of course, the algebraic sum of the e.m.f's of the generator and fly-wheel equalizer, the former always in the same direction and the latter subject to regulation from zero to a maximum value in either direction. When the winding motor is not working, the e.m.f's of the generator and the equalizer are equal and opposite, provided the fly-wheel has reached its maximum speed. In order to start the winding motor, the excitation of the equalizer is gradually decreased and passed through zero to its maximum in the reverse direction to obtain the highest speed, the reverse process being adopted for slowing down or stopping. A great advantage possessed by this system over some better known systems lies in the possibility of shutting down the fly-wheel machine and running directly off the mains, either in case of break-downs to the equalizer or in cases of light load, when the absence of heavy overloads renders it not worth while to incur the losses incidental to the running of the fly-wheel set. —Lond. *Elec.*, August 3.

Elevators.—Kammerer.—In building a hotel in Berlin, which needed 17 elevators for different purposes, the question arose whether to install electric elevators or hydraulic elevators operated by means of an electrically-driven pump. To decide concerning the advantages of each system, comparative tests were made of an electric elevator equipment and a hydro-electric elevator equipment in two different department stores in Berlin. The result was strongly in favor of the electric system. The energy consumed in the hydro-electric system to that in the purely electric system has the ratio of 2.5 to 1. Further, the hydro-electric system requires more space and the expenses for attendance are higher.—*Elek. Bahnen.*, June 23 and July 14.

Electric Power in Rail Mill.—Wiley.—An illustrated description of rail mill No. 3 of the Edgar Thompson Works of the Carnegie Steel Company, which has the distinction of being the first American rolling mill equipped entirely with electric motors. These motors are of the 220-235-volt, direct-current type. There are two main motors of 1,500 hp each, driving rolls, and 18 other motors ranging in size from 25 hp to 90 hp on the auxiliary equipment used in rolling.—*Elec. Journal*, August.

Traction.

Petrol-Electric Automobile.—A note on a system of electric transmission gear for petrol-driven road vehicles, which differs somewhat from some of those which have been tried already. The distinctive features of the arrangement are the use of alternating instead of continuous current and the absence of batteries for the equalization of the load on the engine. Briefly summarized, the system is as follows: An ordinary vertical petrol engine is directly coupled to a revolving-field alternator, the rotor of which takes the place of a fly-wheel. Beyond this, on the same shaft, is a magnetic clutch, which serves to couple the engine shaft to a further shaft carrying the rotor of the alternating-current motor, and connected through the usual universal joints to the worm or bevel gear on the live back axle. A "direct drive" is thus obtained on the top speed when only the magnetic clutch is in use, while the power speed ratios are obtained by running the motor from the alternator, the clutch being free and the whole power transmitted electrically. It is thus seen that both the alternator and the motor have to be of sufficiently large size to develop at times the whole of the power, but the weight of the electrical part of the outfit in the case of a 40-hp equipment is given as only about 975 lb. The stator of the motor is kept permanently connected to the alternator by three stout copper bars and all control is effected, so far as can be judged by the particulars now available, by variations of the excitation of the alternator. A small independent exciter is used which also supplies the current required for the magnetic clutch. An automatic brake is to be provided which is held off only when current is available and the controller is in certain positions; and when

running down hill a considerable effect can be produced by the motor running above its synchronous speed. The system, which is the joint invention of Hart and Durtnall, has not as yet been tried on the road, although some brake tests have been taken on an experimental set.—Lond. *Elec.*, July 27.

Glasgow Municipal Tramways.—The annual report for the year ending May, 1906. The average revenue per car mile has increased, but there has also been an increase in the working expenses per car mile, mainly due to the extra cost of maintaining the permanent way. The costs per car mile during the last year were as follows: The traffic expenses per car mile were 5.92 cents; the general expenses, 2.10 cents; repairs and maintenance, 2.88 cents; power expenses, 0.70 cents; hence total working expenses, including capital charges, 11.60, while including capital charges they were 19.56 cents. The total kw-hours generated were 25,370,859, of which 1,405,843 were sold to the central station, while 19,820,686 were issued for traction load at the substation bus-bars.—Lond. *Elec.*, August 3.

Gas Power.—BIBBINS.—A paper read before the Engineers' Society of Western Pennsylvania on the operation of gas-driven electric power systems, as exemplified in the Warren & Jamestown single-phase railway system, which has already been mentioned in the Digest.—*Elec. Journal,* August.

Simplon Tunnel.—HERZOG.—The first part of an illustrated description of the electric equipment of the Simplon Tunnel, in which three-phase locomotives are used, as has already been mentioned in these columns.—*Elek. Bahnen.*, July 24.

Wires, Wiring and Conduits.

Electromotive Forces Induced in Parallel Circuits.—COPLEY.—The fourth of a series of articles dealing with the characteristics of transmission circuits. In the present article some numerical examples are given how to calculate the electromotive force induced in any circuit by an alternating current in a parallel circuit. —*Elec. Journal,* August.

Installations, Systems and Appliances.

Oils for High-Tension Switches.—BOLAM.—An article in which the author first summarizes the requirements of good oil for switches, and then discusses which oil is most suitable for the purpose. Nearly all oils are good insulators when pure and not deteriorated, and there is little to choose between vegetable, animal and mineral oils on this score, provided the oils are good. But the action of the arc on the oil altogether alters the aspect of the case, for certain oils are so decomposed as to be practically useless in a very short time. The oils used for switch work are usually mineral or resin, but in recent years the latter has fallen into disfavor. The insulation properties are so nearly alike that there is little to choose between the two oils; the resin oil is slightly the better, but it is possible to obtain a mineral oil to withstand 15,000 volts between contacts 0.1 in. apart without any trouble. The arc is readily extinguishable by either oil, but a certain amount of disintegration and consequent deposit is unavoidable. The more quickly the arc is extinguished, the less is the deposit; moreover, the oil should be of sufficient fluidity to free itself, so to speak, of gas bubbles, and present a fresh layer between the contacts. Certain mineral oils, especially those chemically purified, and both animal and vegetable oils are on this score unsuitable; constant switching with heavy currents will ultimately render any oil unsafe. The deposit will, in time, not only spoil contacts, but will cause conduction and leakage between the contacts and the case. Hence, however good the oil, periodic renewal and cleaning must be carried out. An oil which has not been treated by chemicals is essential, so that only a mineral oil of high quality should be used. A resin oil tends, so to speak, to glue the contacts, and for this reason alone its use in automatic switches should be condemned. The flash point of resin oils is low. The best switch oil is a pure mineral oil refined by distillation only; of flash point (C. F. P.) not less than 400° F., free from suspended matters, acids, sulphur or deleterious chemicals, transparent and fluid at 20° F. The oil should not lose more than 0.5 per cent when heated to 212° F. for 12 hours, and must be absolutely free from moisture. The minimum dielectric strength—as hereinafter set forth—should be, for a thickness of 0.1 in., 14,000 volts. The importance of freedom from moisture cannot be exaggerated. It was found that exposure of a vessel of oil for only two days in a damp room caused a drop in the dielectric strength of as much as 25 per cent; the amount of water actually present was not, however, determined. The curves given in Fig. 2 show the results of tests of four switch

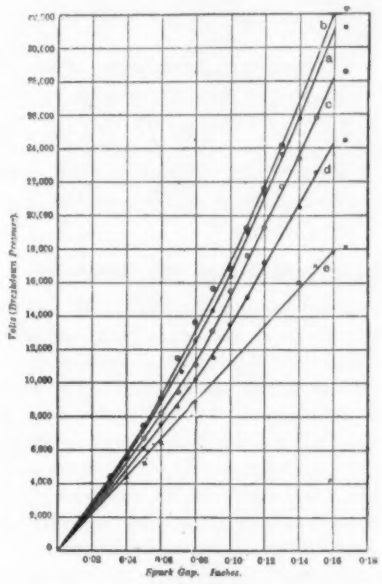


FIG. 2.—RESULTS OF TESTS.

oils, marked *a, b, c* and *d,* in comparison with an ordinary engine oil, marked *e.* The oils tested included (*a*) resin oil, C. F. P. 200° F.; (*b*) mineral oil, C. F. P. 410° F.; (*c*) mineral oil, C. F. P. 430° F.; (*d*) mineral oil, C. F. P. 320° F.; (*e*) engine oil, C. F. P. 380° F. Of these *b* was in every way the most satisfactory; it was transparent and frequent sparking did not appreciably deteriorate the oil.—Lond. *Elec.*, August 3.

Reverse Current Relay.—MACGAHAN AND BAKER.—To protect alternating-current circuits operating in parallel against the reversal of the flow of energy, relays are employed to operate electrically-controlled circuit-breakers, these relays being of some type which would operate when the current reverses. The ideal relay for such a service should consist of a wattmeter fitted with moving contacts, which could be adjusted to trip the circuit-breaker at any predetermined load in true watts in the direct overload direction or in the reverse power direction, but modified so that it would have practically the same torque at low power factors as at high power factors. It should be operative when the voltage becomes zero. It should have the additional features of inverse time element, so as to exercise a selective influence and trip out the circuit in trouble without interrupting the power on those circuits not affected. The authors describe an instrument of this type which consists of two electromagnets operating two discs mounted on the same shaft, the mechanical construction being very similar to that of a polyphase watt-hour meter. Instead of driving a registering dial, however, the shaft is controlled by a spring, and a moving arm is arranged to close a contact connected to the tripping coil of the circuit-breaker. Instead of the electromagnet being wound with the usual series and shunt coils as in the watt-hour meter, a special winding is provided which automatically combines the influences of current alone, of voltage alone and of true watts alone. In the absence of voltage the discs are subject only to the influence of current, as in an ammeter. In the absence of current the relay is in effect operative as a voltmeter. When all these quantities are present in the varying degrees found in practice, there is formed a very effective combination of the three elements, which is taken advantage of to solve the problem of an alternating-current and reverse-current relay. Diagrams are given showing the connections of the relay and results obtained with it.—*Elec. Journal,* August.

Distribution System.—An illustrated description of the distribution system of the municipal station of Bolton, England. In the center of the borough the continuous-current, three-wire system is used at 230 and 460 volts. The system has gradually

been extended until at the present time practically all consumers within a radius of one mile of the generating station are connected to it. The aggregate horse-power of the motors coupled to the direct-current mains, amounts to over 3,500. The single-phase system has been extended to all outlying residential districts, the high-voltage, alternating current being transformed down to 200 volts in underground transformer stations.—Lond. *Elec. Rev.*, August 3.

Switchboards.—Kuebler.—A description of a new design of switchboards devised for the special purpose of avoiding danger to the attendants.—*Elek. Bahnen.*, July 14.

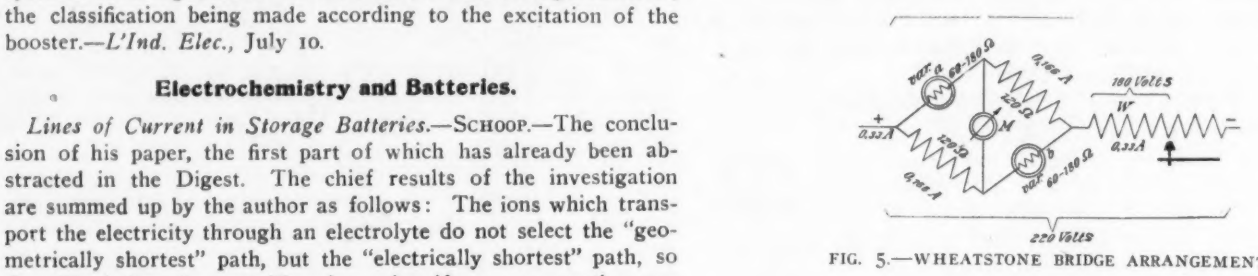
Batteries and Boosters.—Loppe.—A summary of the different systems of using boosters in connection with storage batteries, the classification being made according to the excitation of the booster.—*L'Ind. Elec.*, July 10.

Electrochemistry and Batteries.

Lines of Current in Storage Batteries.—Schoop.—The conclusion of his paper, the first part of which has already been abstracted in the Digest. The chief results of the investigation are summed up by the author as follows: The ions which transport the electricity through an electrolyte do not select the "geometrically shortest" path, but the "electrically shortest" path, so that Ohm's law for metallic wires of uniform cross-section can be applied to electrolytes only in the special case, if there is no straying or distortion of lines of current. In all those cases (that is, in all cases of practice) where the cross-section of the electrolyte is larger than the surface of one electrode, there is an "electrolytic shunt"; the lines of current no longer pass in a straight direction through the electrolyte, and the distribution of the current density over the electrode surfaces is no longer uniform. What is called the "electrolytic shunt" really acts as a shunt, i. e., has the effect of diminishing the resistance. A large number of the troubles experienced with storage battery plates, like distortion of the plates, dropping out of active material, may be easily explained in accordance with what was said above since on account of the layer of acid between the lower rims of the plates and the bottom of the vessel (which layer of acid acts as electrolytic shunt), the plates carry more current near the bottom than at the top. This non-uniform current density at different parts of the plate results in non-uniform changes of volume. This necessarily results in mechanical distortions, whether dealing with pasted plates or Planté plates. This is a point which up to the present time has not been properly considered, especially in the formation process. At a storage battery electrode which is non-homogeneously charged or discharged strong local currents occur. It seems that lead peroxide plates behave in general far more uniformly than spongy lead plates during charge and discharge.—*Electrochem. and Met. Ind.*, August.

Units, Measurements and Instruments.

Automatic Voltage Indicator and Insulation Control.—Kallmann.—**The first part of a long paper read before the Berlin Electrical Society. The author makes use of iron wire resistances with a high temperature coefficient (such as is used as "ballast" in connection with Nernst lamps) for automatic voltage indicators and insulation control. Such iron wire resistances are called by the author "variators."** The simplest arrangement is shown in Fig. 3, where the variator, *V*, is in series with a constant resistance, *C*, which may be regulated by means of *R*. Let 220 be the normal voltage, for which 20 volts are consumed by the variator, *V*, and 200 by *C*. If the total voltage drops to 210, the voltage at the variator, *R*, drops to 11 and at *C* to 199. If the total voltage rises to 230, the voltage at the terminals of *V* is 29 and at *C* it is 201. *J* is a signal apparatus, for instance a bell, and *M* another indicator (galvanoscope, low-voltage voltmeter). This arrangement gives a ten times greater sensibility than can be obtained with a 220-voltmeter connected across the 220-volt circuit. But this is the case only when *J* and *M* have very high resistance, compared with *V*. A differential arrangement is shown in Fig. 4, where the variator, *V*, is in parallel with the winding of the electromagnet, D_1, while the constant resistance, *C*, is in series with the winding of the other electromagnet, D_2. The latter behaves like a permanent magnet, while the tractive force of D_1 changes with the voltage at *V*. Another very much more sensitive arrangement is shown in Fig. 5, the arrangement



FIGS. 3 AND 4.—AUTOMATIC VOLTAGE INDICATOR.

FIG. 5.—WHEATSTONE BRIDGE ARRANGEMENT.

being that of a Wheatstone bridge in series with a resistance, *W*. The two variators, *a* and *b*, are placed in opposite branches of the bridge, while the two other branches are constant resistances. The latter two may be 120 ohms, while the resistance of *a* and *b* varies between 60 and 180 ohms. The article is to be concluded.—*Elek. Zeit.*, July 19.

BOOK REVIEWS.

The Art of Generating Gear Teeth. By Howard A. Coombs. New York: D. Van Nostrand Company. 129 pages, 37 illustrations. Price, 50 cents.

The first part of this little book, which is No. 120 of the Van Nostrand Science Series, is devoted to a discussion of the theory of tooth outlines. It is not intended to be a text-book for the draftsman or machinist, but it gives the reader a clear idea of the application of curves to gear teeth design. The explanations are simple, and with few exceptions all proofs will be readily understood by those not familiar with the higher mathematics. The latter part gives a history of the gear generating machine, from the earliest forms brought out 65 years ago to the almost human machines of to-day.

A Graphical Treatment of the Induction Motor. By Alexander Heyland; translated from the second edition by G. H. Rowe and R. E. Hellmund. New York: McGraw Publishing Company. 48 pages, 28 illustrations. Price, $1.00.

It has come to be thoroughly recognized that the most logical method of treating the electrical characteristic of an induction motor is the one which considers the machine as a special form of the general alternating-current transformer. For dealing with the phenomena connected with the operation of transformers, the graphical method in found to be the most simple, while of all the graphical diagrams that have as yet been purposed for explaining the operation and predetermining the performance of the induction motor none has been found more convenient than the semicircular arcs with which the name of Heyland is so frequently associated. The present little book deals directly with the so-called Heyland diagram, and contains just that amount of descriptive matter which is necessary to review the physical facts upon which the construction of the diagram depends, and to show what success attends the application of the diagram to motors in actual use. Short notes are added on the use of the induction motor as a generator, and on the characteristic difference between a single-phase and a polyphase induction motor. The text is exceptionally free from the expanded array of mathematical formulas which so frequently burden the pages of treatises on induction motors, and no one who is in the least familiar with graphical methods will experience trouble in following the explanations.

HAND BOOK OF BARE AND INSULATED WIRES AND CABLES. By Joseph W. Marsh. No. XVII. Pittsburg: Standard Underground Cable Company. 228 pages, illustrated. Price, cloth, 50 cents.

While this book is primarily a trade publication, and, consequently is devoted to some extent to the exploitation of the products of a single cable company, the major portion of the book deals with information of a general character. The book contains six general divisions as follows: Price lists, telegraph code, description of products, working directions, testing, general and electrical information. Although, as the names of the divisions imply, much matter of a trade nature is to be found in the book, more than half of the pages deal exclusively with technical information, and this portion partakes of the nature of a hand book on cable calculation, laying and testing. The information has been compiled from various sources known to be reliable, and it is presented in a manner to render it readily applied.

EXPERIMENTS OF APPLIED ELECTRICITY. By Arthur J. Rowland and William B. Creagmile. New York: McGraw Publishing Company. 181 pages, 60 illustrations. Price, $1.25.

This little book is intended as a laboratory manual for students in electrical engineering in technical schools and manual training schools. It is arranged to cover the work to be undertaken after a student has become somewhat familiar with elementary physical experiments and previous to his entering upon the design of electrical machinery. The work outlined covers seven experiments in electrostatics and magnetism, twenty experiments with battery currents and forty-one experiments with dynamo currents; the last class of experiments include characteristics and efficiencies of direct-current generators and motors, and studies of alternating-current generators, motors and transformers, and also the photometry of incandescent lamps.

The writers have made a special effort to avoid the use of the symbol *I* for current, as recommended by the committee of the American Institute of Electrical Engineers on Standardization, and as adopted by practically all writers on electrical engineering subjects, and have stated their preference for *C* as the initial letter for current; although descriptions of three experiments in electrostatics are included, no intimation is given of the author's choice for a symbol for capacity. In view of the facts above stated one is not surprised to find on page 80 the statement that power is measured in watt-hours, and to learn that throughout the whole book no distinction is made between magnetism and copper when applying the term "field." Although the above-mentioned discrepancies beyond any doubt whatsoever do lead to confusion in the mind of a student who is just beginning to become acquainted with electrical phenomena, they are by many people considered of minor importance and do not detract seriously from the value of the book, which, in fact, is well suited for the purpose for which it is intended.

ELECTRIC TRANSMISSION OF WATER POWER. By Alton D. Adams. New York: McGraw Publishing Company. 335 pages, 105 illustrations. Price, $3.00.

This useful volume is not in any sense a formal treatise on engineering, but rather an interesting résumé of current practice in long-distance power transmission. Its conspicuous virtue is the gathering together of a great amount of data as to how things are done in every-day transmission practice, facts that represent a great deal of labor in the gathering, and which are not elsewhere placed within the reach of the working engineer. Its failing, from the standpoint of the inexperienced reader, is that the facts are put on record without discriminating comment, exceedingly good practice and exceptionally bad practice being thrown together on an even footing. In some instances notes of changes in equipment or of conspicuous failure throw some light on the situation, but by and large the method is one better suited to the needs of the advanced student than to those of the novice. The volume would make useful reading for engineering students under the direction of an instructor able to point out the bearing of the methods described on the problems of practical construction. Its arrangement is good and a great deal of important and minute information is put in shape to get at easily. Such things as the details of pole line, pin and insulator construction are not easy to obtain, and they are here given for many plants with frequent references to the original descriptions. The chapters dealing with these subjects are decidedly the best in the book, while the least satisfactory is perhaps that on guard wires and lightning arresters —a difficult subject at best, but from which the reader in this case will be able to extract very little that is definite or a safe guide to practice. In spite of such minor failings the book has a distinct place in the engineer's reference library. It is well illustrated, being especially free from hackneyed cuts, presenting rather effective pictures of typical recent constructions. There are, in addition, many useful tables of dimensions and other pertinent data convenient for reference. Altogether it is a volume well worth reading and decidedly instructive.

EVOLUTION OF WEIGHTS AND MEASURES AND THE METRIC SYSTEM. Halleck & Wade, New York: The Macmillan Co. 304 pages. Price, $1.50.

This volume contains a very interesting and instructive account of the development of weights and measures and particularly of the efforts of the last century in the establishment of a universal metrological system, now happily completed for all scientific purposes. It is to be regretted that the authors could not have found space for telling more in detail the curious history of the English weights and measures in which survive relics of at least half a dozen "systems." The account of the origin and growth of the metric system itself is satisfactorily full and especially useful. The general source of the system is of course well known, but not so familiar is the story of its gradual growth and final acceptance by most civilized nations. Especially it is pertinent to note the complete failure of the early attempt in France to adopt metric measures with names already in use, although in some other states a similar measure was more effective, and the early adoption of the Z all pfund helped the cause greatly. English speaking peoples have been cursed with probably the worst conglomerate of legalized weight and measures ever known, and it is greatly to be regretted that England could not have been a party to the trade union that did no much for Continental countries. Not only are English measures utterly without system, but they are related by ratios that combine very badly even with English monetary units, and still worse with American ones. The fatuous stupidity of trying to use a mixture of binary, tomary and duodecimal measures complicated by accidental irregularities, in combination with decimal arithmetic and coinage beggars description.

If there were no other reason for change this alone would justify almost any effort. The most conservative educators place the saving of time in education by the use of the metric system at a school year. It is certainly a fact that for two or three years of the child's life practically all the time spent on number work of any kind is frittered away by reason of neglect of decimal arithmetic in favor of the curious mixture forced upon him by our stupid metrological system. With the metric (or any other decimal) system in full swing, not only would the difficulties of weights and measures and "even compound numbers" vanish, but the vulgar fraction, with its interminable and wholly useless complications would drop almost out of sight. A child could learn in a fortnight all of common fractions ever now used in practice, and would never be bothered with them again, save as the symbolic theory might turn up in the higher mathematics. The truth is, that the teaching of arithmetic is nearly two centuries behind the times, harking back to the days when decimals were a curiosity affected by the learned, logarithms practically unknown, and algebra a branch cultivated only by a few erudite professors. More than this with the metric system in use the lack of a simple numerical relation between foot and meter becomes of no consequence whatever, since the former and all its multiples and sub-multiples would soon become as extinct as the Babylonian cubit. As soon as a carpenter begins to work by a metric rule alone, that is the end of the matter, and he ceases to have much interest in the number of centimeters to the foot. Even during the transition period the question of exact numerical correspondences would seldom arise for objects as made without the use of jigs and gauges which can be on one system as well as another are not made to exact dimensions.

In fact, if one were given a metric and an English rule and placed in a room containing a pile of miscellaneous articles he would find it practically impossible to determine whether they had been intended to fit one scale or the other. This side of the matter is well set forth in our author's capital chapter on the metric system in manufacturing. In America the chief objections to the metric system come from the machine screw makers who have a personal axe to grind, and from the textile manufacturers, of all men the most conservative and cautious. They have come also to employ an extremely low grade of labor, aside from foremen, and experience has shown that the lower the average standard of intelligence and education the slower has been the progress of the metric system, so that a change in the textile arts would be unquestionably more difficult than in branches of manufacture requiring a higher grade of labor. There is also in the textile business a considerable group of English workers who have their insular prejudice more than their countrymen and look up English measures as given of God, and metric measures as in themselves accursed. A few industries cannot from selfish motives indefinitely block progress and all signs in England point to a change within a few years. The grim accessories of international trade will force the metric system into use in spite of every kind of opposition. This phase of the matter might well have been given more space in the volume under consideration. While the American manufacturer is setting his face against any innovation the German and the Belgian are actively at work building up foreign trade by courteous concessions to the needs of the customers. They ship goods in metric measure where the American fails through neglect or obstinacy to find a market, and year by year elbow American competition out of the way. In a few years they will bring to bear a pressure that will make English speaking people bitterly regret their slowness in accepting international standards.

Selective Electrical Signaling Devices.

By Henry E. Vineing.

For several years past the field of endeavor in this class of electrics has been kept quite busy, as shown by the many devices engendered from the requirements of selective calling for telephone party lines and the like. In fact, with one meritorious exception, all have more or less traveled in the usual prescribed grooves that the inventors are prone to follow. Owing to the simple generic principle underlying the exception above mentioned, it is well that all who are interested in apparatus of this class should take notice of the ease and simplicity both mechanically and electrically by which positive results are obtained in the new Kennedy fire alarm box. Up to the present time it has been a mooted question whether or not there were any fire alarm signaling apparatus that might be truly called "successive" in actual practice. Several such apparatuses have been placed in use from time to time, but for some reason or other they have been found, in the main, unsatisfactory. A careful canvass of the opinions of engineers and others having charge of or connected with municipal fire alarm telegraph systems in which "successive" appliances have been or are now in use, shows that all agree that the successive principle is absolutely essential in a fire alarm telegraph system, but that the methods used do not insure the reliability of the apparatus now obtainable in the first case, and that no system in use is really successive except to a very limited extent. The consensus of opinion is that with only a limited number of the instruments on the same line being capable of working in succession, there is no valid reason for the expenditure required for succession apparatus.

The principle underlying the construction of so-called successive fire alarm apparatus of itself determines the failure of the same—the reason being that when operated for a call, the clockwork or

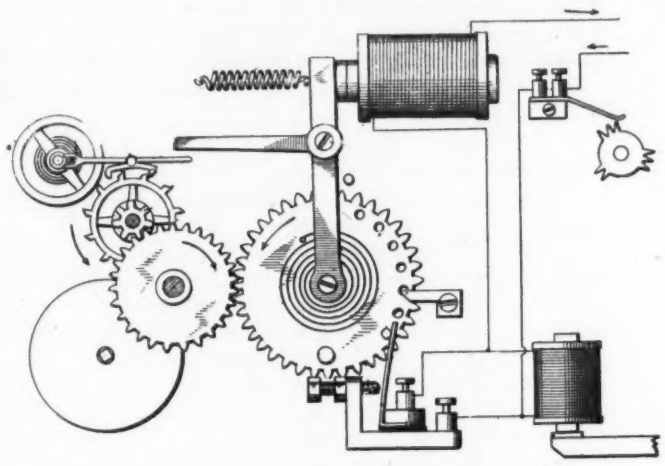
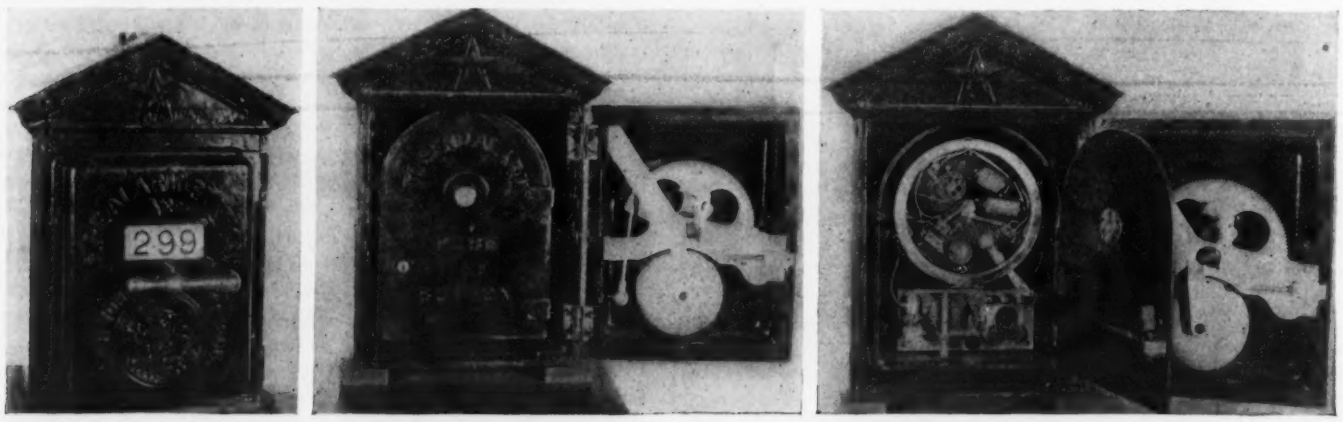


FIG. 1.—DIAGRAM OF FIRE ALARM BOX MECHANISM.

driving mechanism starts; and as this mechanism is so constructed as to run down within a predetermined time, it is therefore absolutely impossible for more than two or three of the instruments to be successive. When, say, 10 instruments on the same line are operated at or about the same time, it is not within the possibility for any instrument to send its signal when run down, and the time element predetermines that when two signals have been received, all the boxes will by that time have run down. With this explanation it is easy to trace the objections made to the present form of "successive" fire alarm telegraph boxes.

Having now explained briefly the deficiencies existing in present apparatus, the simplicity and ease by which such objections are removed and true successive operation is obtained by the use of the Kennedy fire alarm signal box, may be noted. Referring to Fig. 1, it will be seen that the generic principle is that of holding the signaling sending mechanism immovable until such times as the line becomes in receptive condition for a signal. This is the first and most important step: when the line is in receptive condition to determine the succession of operation of any or all instruments on the line. This is clearly shown as being accomplished by the simple process of changing the position of a pin in each box, on the wheel for that purpose.

It is immaterial whether there are one or fifty boxes on the line



Figs. 2, 3 and 4.—Fire Alarm Box Closed and Open.

and whether one or the whole are operated at the same time. In the event of any number being operated, and the pin being in a different position normally in each box, it is readily seen that only one box will go off, and at its completion of work the next having its pin in advance of the others will be operated, and so on until all have been received.

Figs. 2, 3 and 4 show the box as at present made, and which contains all the improvements up to date. Fig. 5 is a diagrammatic view of the circuit for guidance of experts.

Fig. 6 is another improvement contained in the Kennedy box,

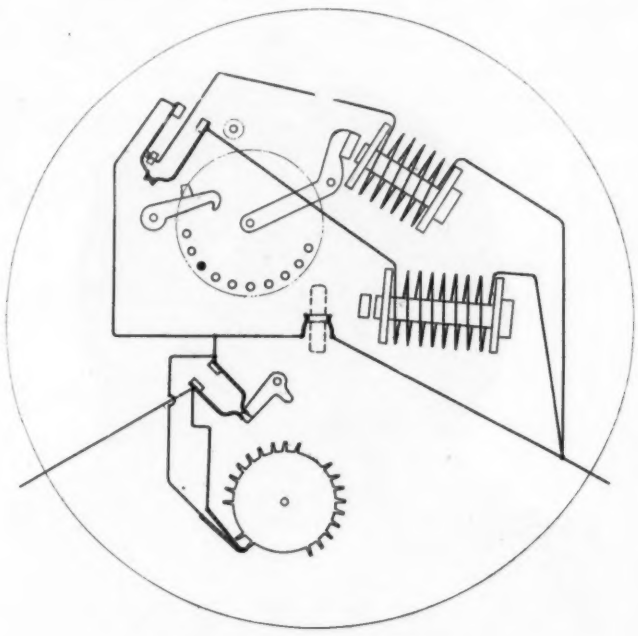


FIG. 5.—DIAGRAM OF CIRCUITS.

whereby the operating device is used as auxiliary and prevents the cutting into or attaching to the box, auxiliary apparatus for auxiliarizing the box (according to the method at present in vogue). This apparatus has been devised and worked out by Mr. Patrick

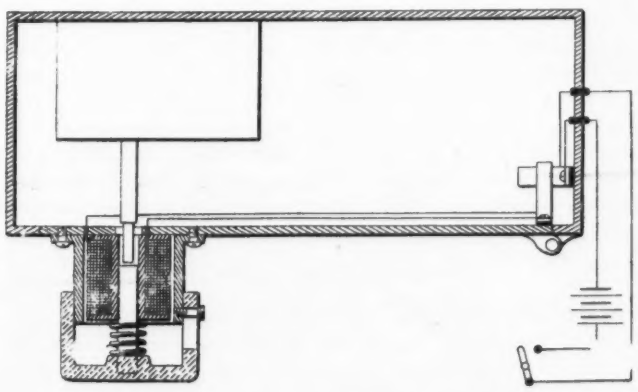


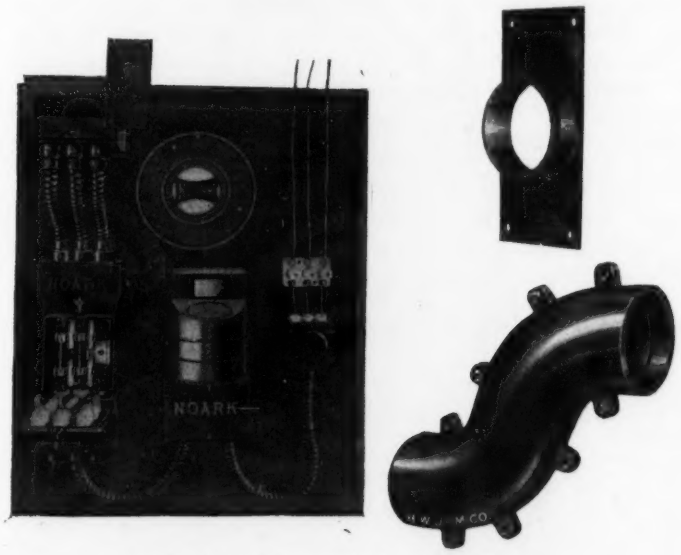
FIG. 6.—DIAGRAM OF DETAIL IMPROVEMENT.

Kennedy, well known as a successful worker in the field of train lighting, and chief engineer of the Consolidated Railway Electric Lighting & Equipment Company of New York City, who has taken out several patents on the invention.

Improved Inlet and Outlet Service Connections.

The National Board of Fire Underwriters require that service conduit shall be continuous, and in order to meet these requirements the arrangement (shown in Fig. 1) has been placed on the market by the H. W. Johns-Manville Company, New York. The service box clamps, which are made in sizes to fit over 2-in., 2½-in. and 3-in. iron pipe, and 3-in. fibre conduit, are split and bolted together in order to make a tight fit to the pipe. The box is made in one piece with two openings, one in the back and the other in front, and it may be twisted so as to allow the conduit to come out from top, bottom, either side or the front. The box may also be used on a dead-end box, using the blank plates and coiling up the cables inside. A dummy plate is placed over the opening not used and on the other opening is placed the tube plate with three openings. If the cable to be used is large and three single conductors, as for direct current, the three openings are used. If three small conductors are used, then two of the holes are filled with blank bushings.

Sprague flexible conduit is used for a conduit between the service box and "Noark" service switch, as shown. Bushings to take ⅜-in., ⅝-in., ¾-in. and 1-in. Sprague conduits are used when the cable or wire is small. The openings in the plates will take 1¼-in. Sprague conduit without bushing. For alternating-current work and when cables are over 80,000 cir. mils, a plate, as shown in Fig. 2, which will take 2½-in. iron pipe, is used. If it is necessary to go up or down from service box, a split elbow, as shown in Fig. 3, is used, and iron pipe is continued to "Noark" service switch. The Sprague conduit is continued to a guard which fits over the switch box, these guards being made right and left in order to go on either side of the service switch box. The end of the guards take the same plate as the service box and



FIGS. 1, 2 AND 3.—FORMS OF OUTLETS.

any combination can be effected. From the service switch box double-braided wire in Sprague conduit is used to the meter box. The latter box is made of galvanized iron with holes punched in to take the conduit. From the meter box the conduit continues to the cut-out for the house wiring.

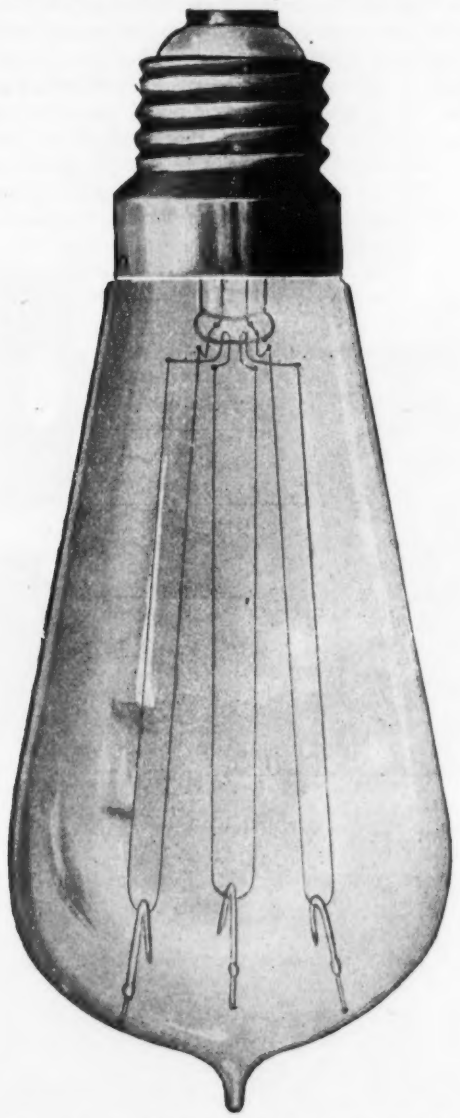
A number of different combinations may be made with these parts. Overhead service may be brought in direct to the service switch box. Alternating wires may be run by bringing cables or wires through one conduit, while large-sized cables may be used on direct-current service by employing the three openings. If a customer is disconnected and material is removed there is no waste, as all parts, even the conduit, may be used again; and the time consumed by the wiremen is less in installing than that with a moulding job. The system practically prevents tampering with the wires between the meters and the service, as no tapping can be made without giving evidence that the wiring has been tampered with. Any number of customers may be taken off service by use of cut-outs and bus lines. The Brooklyn Edison Company, of Brooklyn, N. Y., installed over 1,000 services of this type.

The Wolfram or Tungsten Lamp.

Mr. Julius Auerbach, president of the Electrical Accessories Company, New York, has just returned from Europe, where he spent nearly two months in the study of the "Wolfram" or tungsten incandescent lamp now being put commercially upon the market in Austria and Germany. Mr. Auerbach is the authorized American representative of the owners of the patents to exploit

or to dispose of the United States patent rights, and has brought over with him a number of these lamps for 110 volts.

The tungsten lamp referred to is the invention of Dr. Alexander Just and Franz Hanaman, formerly of the Imperial and Royal Technical High School, of Vienna. In appearance and design the lamp closely follows the lines of the familiar carbon filament lamp, as shown in the full size cut herewith. Mr. Auerbach claims that the above-mentioned inventors were the first ones to make a pure tungsten filament, and that their method of manufacturing enables them to make lamps commercially as low as 25 cp, consuming one watt per candle, and with only three filaments. The life of these lamps is put by Mr. Auerbach at not less than 1,500 hours. The European manufacturers are at present bringing on the market a standard tungsten lamp of 40 hefners cp, consuming 40 watts. (See cut.) Tests have been made of these lamps made in Vienna, Munich and Berlin. Prof. Reithoffer, of Vienna, says in his report on this lamp of January, 1906, "A like efficiency has never been reached by any incandescent lamp; this efficiency in fact approximates very closely that obtained with arc lamps, and indeed would seem to have reached the limit of what possibly can be achieved in incandescent lighting." These lamps burn on direct as well as alternating currents, and in this respect differ from the tantalum lamp, which does not stand up so well on alternating current as on direct. The filament of the lamp shown is 17 in. in length.



STANDARD 110-VOLT, 40-HEFNER CANDLE WOLFRAM LAMP—FULL SIZE.

Electric Drive for a Sawmill.

An interesting example of electric drive for a sawmill is furnished in a plant to be installed by the Allis-Chalmers Company at Tacoma, Wash., for the Dempsey Lumber Company. The electric plant will be driven from separate engines for generating of electric current for lighting purposes, as well as for operating the planing mill, where each machine will be driven from individual motors. The equipment for the electric plant consists of a Reliance Corliss engine direct-coupled to a 300-kw, 60-cycle, three-phase engine-type generator, two 25-kw exciter sets and eleven Allis-Chalmers induction motors of various capacities for driving individual machines.

Two 10-hp motors will drive the trimmer saw. A 30-hp motor will be direct-coupled to a rip saw. Another 30-hp motor will operate a moulding machine and two 40-hp motors will run matchers, to which they will be direct-coupled. A band saw will be driven by a 40-hp motor and a 100-hp motor will be belted to a blower equipment. A planer and a twin matcher will each be driven from 50-hp machines.

40-HP INDUCTION MOTOR FOR DIRECT CONNECTION TO MATCHER.

The generator is an engine-type machine with revolving field. The armature is stationary and bears the high voltage winding. Each armature coil can easily be taken out and repaired in case of injury, thus insuring minimum loss of time for repairs. The generator is separately excited from an engine-driven exciter with current at 120 volts. One exciter is direct-coupled to a 440-volt, three-phase induction motor, while the other is driven from a New York safety engine.

"Snowball" Flaming Arc Lamp.

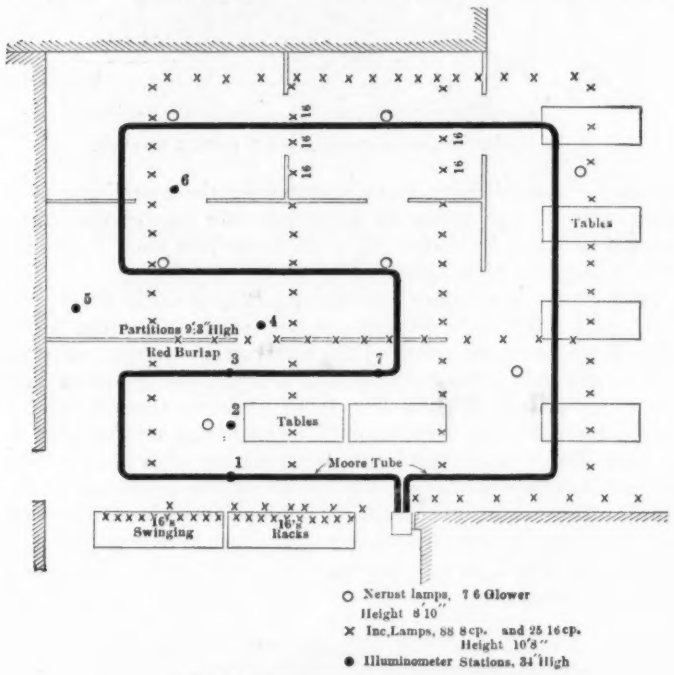
The Excello Arc Lamp Company, 24 East Twenty-first Street, New York, has lately introduced its "Snowball" flaming arc lamp for which many advantages are claimed. The lamp is intended for indoor use and possesses a full and pure milky white light, pleasing to the eye and remarkably steady. The current consumption of the lamp is 10 amp. and the potential across the arc is 90 volts. The whiteness of color is, of course, obtained by the use of impregnated carbons, which unlike the other carbons used in various other types of Excello lamps does not possess a metal core. The positive carbon has a mineral core and the negative carbon is solid. The lamp does not differ in construction from the other lamps made by the company except in the magnets and carbons. The maker also claims that there are no fumes given off and that the amount of dust is negligible. It is contended that when the lamp is properly adjusted for the circuit conditions a higher temperature at the arc is produced resulting in the complete combustion of the carbons. Exterior resistance is provided for lamps on direct-current circuits and reactance coils for lamps on alternating-current circuits, so that the lamps are adapted to burn on any and all circuits. The vital part of the lamp is en-

closed and isolated as much as possible from the lower part of the lamp. The candle-power of the lamp is claimed to be about 2,500 mean hemispherical and owing to the shape of the globe the distribution is said to be greatly enhanced.

Tests of Moore Lighting Tubes.

Some comparative tests were recently made by the Electrical Testing Laboratories in the picture department of the store of L. Bamberger & Co., Newark, N. J., on illumination from Moore tubes, Nernst lamps and incandescent lamps. The accompanying cut indicates the distribution of the several sources of light.

The Moore tube was 179 ft. long and 1¾ in. in diameter, installed 9 ft. 6 in. above the floor, the height of ceiling being 10 ft. 11 in. The tube had been in service about 1,000 hours at the



ARRANGEMENT OF LIGHTING TUBES.

commencement of the test. The Nernst lamps were seven in number of the six-glower, alternating-current type, with opalescent globes of bluish tint. Within 24 hours before the test they had been equipped with new 250-volt glowers. The incandescent lamps were wired to molding on the ceiling except 20 16-cp lamps used with opaque reflectors for the illumination of some swinging racks; these latter were of practically no utility in illuminating any of the stations investigated. The total number of incandescents was 88 8-cp and 25 16-cp, all having clear glass bulbs.

Measurements of illumination were made at seven points in a horizontal plane 34 in. above the floor. These test points were located in the space between the exhibition racks, whose illumination constituted the chief object of the installations, and are indicated on the accompanying diagram. The ceiling of the illuminated space was metallic, finished in cream color. The walls and partitions were covered with red burlap, upon most of which pictures were mounted.

The intensity of illumination was determined by means of a Weber photometer, especially arranged for work of this character.

All electrical values in connection with the Moore tube and the Nernst lamps were determined by instruments placed in circuit upon the service during the test. Because of differences in wiring arrangements for the incandescent lamps, similar values could not be determined without great difficulty. Consequently it was decided to remove nineteen (19) of the lamps from their positions and by supplementary test, considering these lamps as representative of all those installed, determine with sufficient accuracy the total power consumed by the incandescent lamps as installed. With this end in view the voltage conditions were carefully determined during the test and supplementary tests at Electrical Testing Laboratories upon the incandescent lamps were made at voltages as determined. All the illuminants were used without reflecting devices of any kind.

The unit of illumination used was the lux and is equivalent to the illumination produced on a plain surface by a source of one candle-power at a distance of one meter, the rays of light falling upon the surface perpendicularly. One foot candle is equal to 10.76 luces. All figures setting forth consumption of power by the Moore tubes are measures of total power consumed, including all auxiliaries. The periodicity of the current was 60 cycles. The average voltage during the test was 243 volts for the Moore tube, 244 volts for the Nernst lamp and 117 volts for the incandescents. The above table gives the results of the test.

	Moore.	Nernst.	Incandescent.
Height of illuminant above floor...	9 ft. 6 in.	8 ft. 10 in.	10 ft. 8 in.
Kilowatts	3.15	3.92	4.13 (est.)
Volt-amperes	5640	3890	—
Indicated power factor	56%	Unity.	—
Average intensity of horizontal illumination	63	44	15
Average variation from mean—index of degree of uniformity	20.3%	41.7%	28.1%
Average luces per unit of power.	20.0	11.2	3.6

Briquette Fuel.

In Europe a considerable industry has developed in the briquetting of fuel materials which formerly represented merely waste or by-products, and the possibilities of this means of fuel economy are beginning to be recognized in this country. Some orders recently placed here for fuel briquetting machinery are particularly significant, both on account of the prominence of the purchasers and because the machinery is of American manufacture and will replace the best-known European machines. Moreover, each of the plants represents a distinct proposition in the briquetting field. One of the purchasers is Mr. Edward B. Arnold, a large dealer in coal, with offices in the Washington Building, and yards at the foot of West Forty-eighth Street, New York City. His plant is to briquette anthracite coal. Another is the Semet-Solvay Company for its plant at Detroit, Mich., one of several large plants owned by this company. This briquetting plant is to produce first-class domestic fuel from coke breeze, a by-product. The third is the Montreal Light, Heat & Power Company, which will use the coke breeze resulting from gas-making operations, with coal tar pitch as a binder, for the production of smokeless briquettes for domestic consumption. The first-mentioned case represents that part of the industry which has its basis in the fact that at the coal mines there are always large quantities of fine or small sizes of coal produced which either cannot be marketed or are sold at a loss to consumers in that condition. These small sizes when put into the form of an attractive briquette can be sold for as much as the highest priced sizes of natural coal, and experience has shown that they even sell for more. In fact, when properly made briquettes become known to the public they may have a preference in the market because of the regularity of their size and form and their even-burning and lasting qualities.

Wherever the fuel market is enough removed from the coal fields to bring the price of coal above three dollars, wholesale, per ton, it will, it is stated, pay handsomely to make the mine dust and breakage into briquettes. This manufacture of briquettes will be done as a rule where the market is, and not at the mines. There are several good reasons for this. The freight rate, for instance, is much less on fine coal than on briquettes or on the more valuable sizes of coal, and even if this difference did not exist it would be, for many other reasons, more desirable, cheaper and better to make the briquettes near where they were to be used.

The great fields for briquetting fine coal will then be at tidewater in the New York Metropolitan District, throughout New England, New York and Canada in the East, and in the West from the Rocky Mountains to the Pacific and in the lignite fields of the Northwest. Parts of the South, too, with its awakened industries, ought to furnish an excellent market for such fuel.

The Mashel briquetting process and machinery, which will be used in the above plants, were designed and developed expressly to meet the American conditions of manufacture and the American consumers' fuel requirements. The briquettes produced are

cleanly and easy to handle and use, and the plants are absolutely automatic. No hand-labor is required from the time the dust is delivered to the machines until after the finished briquettes are spouted out into wagons or cars to be delivered to the consumers.

The process consists principally of crushing the material to an even size, drying and heating it, then introducing the binder in such a manner that each particle of coal receives a very thin coating; then passing the mass through a tempering process, and from there to the press. From the press the finished briquettes go to a cooling table from which they are dropped or elevated to the storage bins or cars.

The drying, heating, mixing and tempering operations are all performed in an efficient and inexpensive machine. Superheated steam, fuel oil or coal are used to dry and heat the material, the nature of the material to be briquetted determining what heating agent it is most desirable to use. The weight of the briquette ranges from 1¾ ounce to 5 ounces, varying with the material they are made from and the purpose they are intended for.

The cost of manufacturing briquettes by the Mashek process, exclusive of the coal dust, but including the pitch for binder fuel for boilers, dryers and heaters, lubricating oil, wear and tear and labor, is stated to be 76 cents to 92 cents per ton, depending upon the kind of material briquetted and the location of the plant in regard to freight charges on pitch, cost of labor and fuel for boilers.

The Traylor Engineering Company, 114 Liberty Street, New York, will install the machinery. The design of the machinery and the installation of briquetting plants is under the supervision of Mr. G. J. Mashek, the inventor and patentee of the system.

Water-Wheel Governors.

The accompanying illustrations show governors which have been designed with special reference to use with hydraulic turbines for driving electric generators. The governor shown in Fig. 1 is intended for turbines having gates operated by rotary shafts. It consists of a shaft-type centrifugal governor at the top, controlling, by means of a long vertical lever, the valve attached to the side of the cylinder. The valve admits oil under pressure into the cylinder, the piston of which rotates the gate shaft by means of a concealed steel rack and pinion. This governor is built in five sizes. In the two smaller sizes, the admission to the cylinder is controlled by a hardened steel piston valve operated directly from the governor lever. In each of the three larger sizes use is made of four poppet valves to give admission and exhaust as indicated in Fig. 2. The poppet valves are not controlled directly by the centrifugal governor, but are opened by a small hydraulic piston, the movements of which are controlled by a small pilot valve operated by the centrifugal governor. Of the four valves the upper pair take care of the downward pressure and exhaust, while the lower pair control the upward movement of the piston.

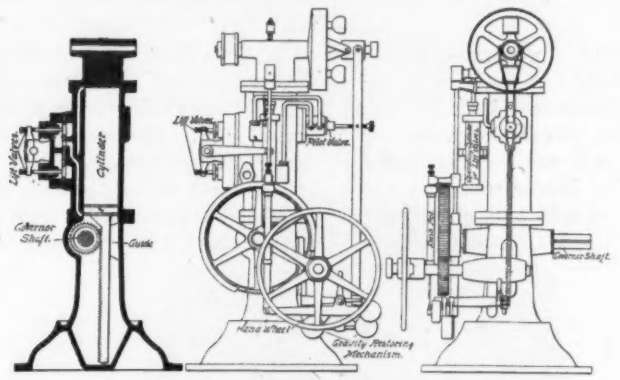


FIG. 2.—ADMISSION CONTROLLED BY POPPET VALVES.

In the type of governor illustrated in Fig. 3 use is made of a rock shaft, operated by an arm-and-link connection to the piston rod of the main cylinder. This construction permits of very simple and inexpensive connections between the governor and the water wheel. With each type of governor there is used a compensator for the prevention of racing. The compensator is a relay device which performs the function of a dash-pot to dampen out any vibratory movements of the governor mechanism. Each governor equipment is provided with an oil pump which is operated continuously, drawing from a vacuum tank and discharging into a pressure tank. The latter is half filled with oil above which there is maintained an air cushion at a pressure of from 150 to 200 lb. per sq. in. The pumping apparatus in each case is arranged as a self-contained pumping unit.

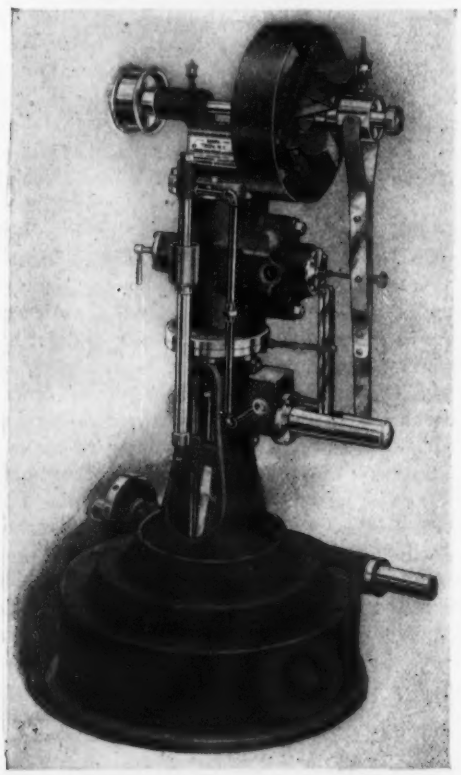


FIG. 1.—GOVERNOR FOR PRODUCING ROTARY MOTION.

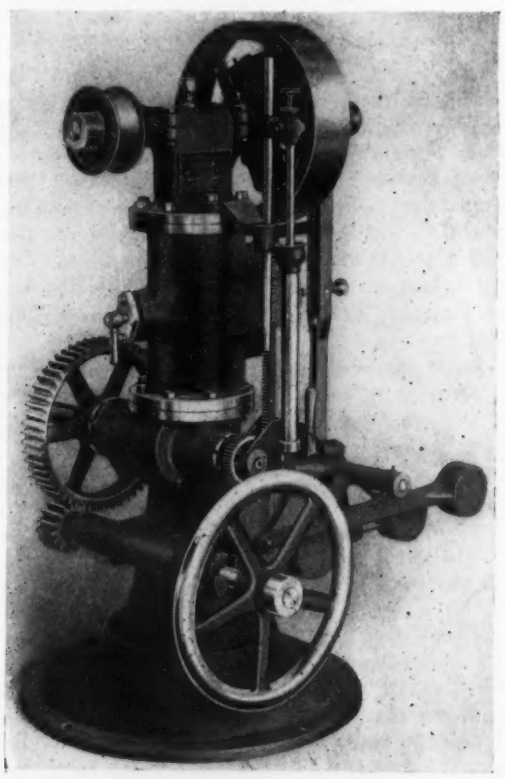
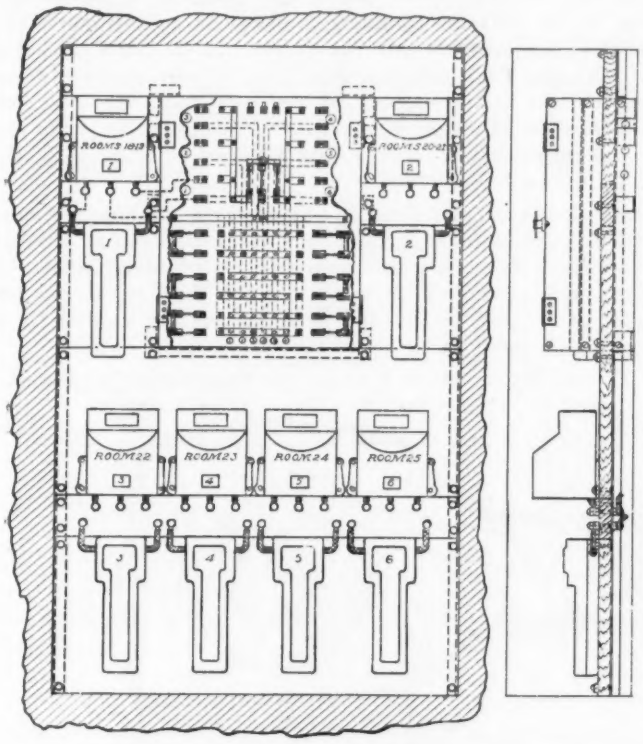


FIG. 3.—GOVERNOR FOR PRODUCING OSCILLATORY MOTION.

These governors are built by the Sturgess Engineering Department, of the Ludlow Valve Manufacturing Company, Troy, N. Y.

Metering Panel Board.

The accompanying illustration shows a type of panel board for use in places where there are many tenants, the personnel of which is constantly changing, necessitating frequent changes, re-



TYPICAL METER CLOSET.

arrangements and combinations of rooms. The board consists of a slate or marble panel, on the front side of which the distributing bus bars are run horizontally with the necessary switches, fuses, etc. Around the entrance of the mains are grouped the meter loops. These meter loops are connected through the slab with a set of bus bars on the back or reverse side of the slab, known as meter bus bars. These meter bus bars run vertically and cross at right angles the distributing bus bars on the front of the board. At every other point of intersection a hole drilled through the slab admits of the connecting of the meter bus bar with the distributing bus bars on the front. This is done by means of a copper screw plug which is run through the distributing bus bar on the front of the board, through the hole in the slate, and screwed into the meter bus bar on the back. To make a change of connections between a light circuit and a meter it is only necessary to remove the meter plug and insert it at the point of intersection which will effect the desired combination. By means of these numbers the combinations can be determined instantly and with no opportunity for mistake.

These boards are being placed on the market by the J. Lang Electric Company, 116 North Lincoln St., Chicago, Ill.

Induction Motors for Driving Lumber Machinery.

In many respects the conditions encountered in lumber mills present problems in power transmission that are not found in other industries. The inflammable nature of the material used, the size of the work handled and the severe power demands for starting and operating wood-working machinery of necessity require a motive power that is not only immune from fire risk but one that will withstand heavy fluctuations in load and operate the various machines with as little obstruction to the handling of material as possible.

These conditions have been fulfilled only partially in the past by the use of overhead belting and shafting driven from a central source of power, which is transmitted through numerous countershafts to the final point of application. In such installations there is an excessive loss of power in friction, which is increased by the slipping of belts and the severe fluctuations of load. Belts and shafting also obstruct the free handling of material and add to the fire risk on account of the accumulation of dust and grease on pulleys and around bearings.

The foregoing conditions led to a demand for some method of operation that would in the main eliminate many of the objectionable features, and electric drive was the natural outcome. By its adoption the various floors and sections can be subdivided so that any machine or group of machines may be operated independently, producing a flexibility which is especially valuable in overtime work, when power requirements are small. Further, it avoids overhead belting and shafting, which removes the objectionable features attending their use.

It was these considerations that led the Eggers & Graham Lumber Company, of Uniontown, Pa., to adopt electric drive in its mills, and the installation furnishes an excellent example of this mode of operation.

The electrical equipment consists of Westinghouse two-phase induction motors operating on 60-cycle, 200-volt circuits, the electricity being furnished by the West Penn Railways Company.

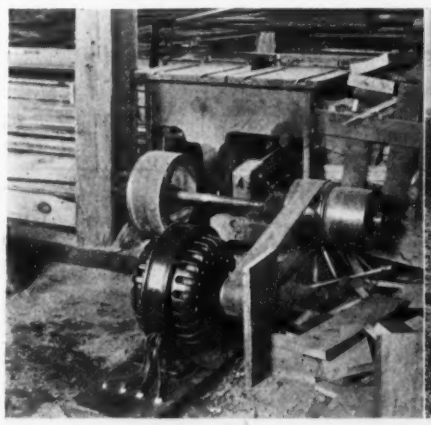


FIG. 1.—CROSS-CUT SAW DRIVEN BY A 5-HP MOTOR.

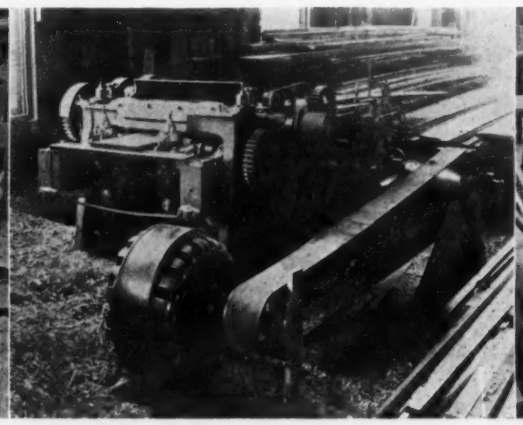


FIG. 2.—PLANER DRIVEN BY A 15-HP MOTOR.

FIG. 3.—TENONING MACHINE DRIVEN BY A 2-HP MOTOR.

Each machine throughout the entire plant is individually driven, as shown by the following enumeration of motors and the machines they drive.

One 5-hp motor driving an emery wheel; one 5-hp motor driving a grindstone; one 5-hp motor operating a rip saw varying from 8 to 14 inches in diameter; one 15-hp motor driving a moulding machine; one 15-hp motor operating a universal planer; one 5-hp motor driving a 10-inch cross-cut saw; one 2-hp motor operating a tenoning machine; one 5-hp motor driving a pony planer; one 4-hp motor driving a panel raiser; one 1-hp motor driving a shaper; one 3-hp motor driving a hand-feed planer; one 3-hp motor driving a hand saw; one 3-hp motor driving a rip saw.

The accompanying illustrations, which show several of these applications, are striking examples of the severe conditions encountered in this class of service. Owing to the rush of work in this plant there is necessarily a large accumulation of shavings and saw-dust, which in some instances nearly cover the motors, furnishing a forcible illustration of the immunity from fire risk secured with induction motors. Some of the motors have covers which, with the accumulation of refuse coming from machines, prohibits ventilation; and that, together with the severe starting conditions, requires motors of exceptional strength, capable of operating under adverse conditions.

The installation, which is operating night and day, is stated to be giving entire satisfaction to the owners, who consider electric drive the only successful method of operating lumber mills.

New Suction Producer Gas Engine.

Recognizing the need for a reliable and economical engine particularly adapted for direct-coupled generator driving, and fed by suction producer gas, the Buckeye Engine Company, of Salem, Ohio, has developed the engine described below. The engine

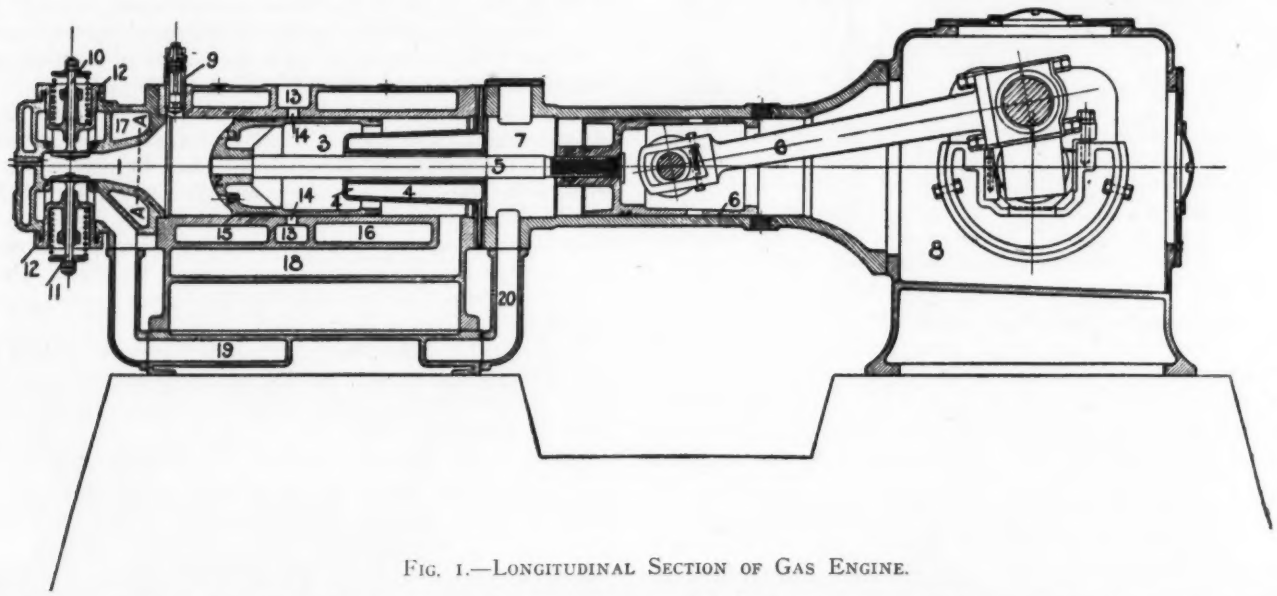


Fig. 1.—Longitudinal Section of Gas Engine.

will, of course, work with other fuels such as natural, illuminating and blast furnace gas, gasoline, etc.

The engine, which is built in sizes from 25 to 500 b.hp, is of the two-stroke cycle scavenging and single-acting type. There are two motor cylinders, two fuel and two air pumps and two cranks, 180° apart. Fig. 1 shows a vertical section through one motor cylinder, one gas and one air pump, and Fig. 2 is a plan of engine. Fig. 3 shows a section through *A B C D* of Fig. 2. Like numbers are used to designate like parts in the various illustrations.

The engine operates as follows: The piston in the crosshead barrel (46), Fig. 2, furnishes air at a pressure of about 8 lb. per sq. in. for scavenging the combustion chamber (1), Fig. 1, and the piston in crosshead barrel (45), Fig. 2, compresses air at the same pressure for scavenging combustion chamber in cylinder (43), Fig. 2. Assuming Fig. 1 to be a section through the right-hand engine, and that the piston (2) is just uncovering the ports (14), then compressed air furnished by the air pump in the barrel (46), Fig. 2, enters the combustion chamber (1), through the valve (11), and the port (19), forcing out the spent gases. A section through the combustion chamber at *A A* is circular and the conical form of the combustion chamber assists in spreading the scavenging charge evenly behind the spent charge. Somewhat later valve (10) opens, admitting into the cylinder a charge of explosive mixture which has been compressed in chamber (3) in front of piston (2). It is thus seen that each motor piston compresses its own explosive mixture, but receives its compressed air for scavenging from the opposite engine. Since valves (10) and (11) are independently driven the relative timing of the admission of the scavenging air and the mixture is under control.

When the piston (2) has covered the ports (14) on the return stroke the compression begins in the motor cylinder, providing valve (10) has closed; this feature being discussed later. The compression being complete, the charge is fired in the usual way.

Fig. 3 shows a section through the piston valve body (30) of the right-hand engine wherein are the two balanced piston valves: (62) for admitting a mixture to gas pump in cylinder, (44), Fig. 2, and (63) for admitting a charge of air into port (69), which is in connection with the air pump in the barrel (46), Fig. 2. Chamber (68) communicates with the atmosphere through the sub-base of the engine. Valves (62) and (63) serve only as admission valves to their respective pumps. The pumps discharge their contents through poppet valves (10) and (11), Fig. 1, as previously described.

A valuable characteristic of this engine is the constant compression and constant mixture said to be obtained at all loads combined with quick and certain response to sudden change of load. The quantity of air passing through the air pumps is constant at all loads, but the amount of air and gas handled by the fuel pumps varies according to the load carried.

The governing system used on this engine combines the good qualities of the fuel and mixture controlling systems used on many two-stroke cycle engines. When the piston valve (62), Fig. 3, uncovers ports (64), the fuel is sucked into chamber (61*i*) and from there through the bpalanced throttle valve (60), into chamber (61), which connects with chamber (18), Fig. 1, the latter being part of the compression chamber of the fuel pump (3), Fig. 1. The amount of fuel passing through valve (60) depends on its position, this being directly controlled by the governor through rod (83), shaft (32), rods (33), (34), etc. When the compressed fuel flows from the pump cylinder (3), Fig. 1, to (83*i*), Fig. 3, and the combustion chamber, it must return through valve (60) or retrace through the same way it entered. Thus valve (60), Fig. 3, controls the amount of fuel entering the gas pump as well as the amount flowing from the gas pump to the combustion chamber. This combination of the fuel piston valve (62) and the throttling valve (60), results in an economy of pump work and quickness of action.

There are two sets of igniters in each combustion chamber, although but one is shown. Shaft (22), Fig. 2, which operates the igniters, is driven by lay shaft (36), Fig. 2, through a pair of spiral gears, one of which is keyed to shaft (36), the other being splined to shaft (32). An adjuster for shifting the splined gear on shaft (22) is shown at (23), thus advancing or retarding the time of ignition of all igniters. The engines are also provided with jump spark ignition apparatus.

A balanced air valve operated by hand or automatically from the lay shaft is used for admitting compressed air for starting. The main admission valves, together with cages, are in exact duplicate and interchangeable. As only relatively cold gases pass through these valves, they are assured of long life.

Referring to the fuel pump cylinder (3), Fig. 1, the water in

the jackets (16) and (4*i*) is kept as cool as possible, thus tending to keep the temperature of compression low. The head (4), Fig. 1, has on it a water-jacketed sleeve (4). This sleeve is babbitted and bored out and on account of its length the speed of reciprocation and low pressures on either side, there is no leakage through the sleeve, and it is subject to little or no wear whatever. In the wrist end the connecting rod has wedge adjustment, and in the crank end it is of the marine type.

The main bearings contain babbitted shells of ample area and have complete means for alignment and taking up wear. In this type of engine, owing to the action on each connecting rod of the combined air and fuel pumps and motor piston, it makes no material difference whether the wrist and crank pin bearings are carefully adjusted since the pressure is always in the same direction. The crosshead pistons and main bearings are oiled by splash oiling, while the spiral gears driving the lay shaft are immersed in oil. Bearings (24), (25), Fig. 2, have ring oilers.

The ignition is always certain from full load to no load, and on account of the combined cooling action of the water jackets and the scavenging air, a high degree of compression can be carried.

Another important feature in the engine is that expansion can be carried to any point whatever. The fuel valve can be so set that the compression may begin, say, at half stroke; in which case the expansion would be to twice the volume admitted. In the smaller sizes this feature will not be made use of, but in the larger sizes an increased thermal economy is thus available.

Suction producers require a variable amount of draft for their operation due to varying conditions of the fuel bed. Here a great advantage is obtained since the fuel pump in this engine has ample capacity to supply the engine with fuel no matter what the draft may be within large limits and a producer can in emergencies be forced beyond its rated capacity without seriously diminishing the power of the engine.

This engine is also self-cleaning, which feature is valuable when using jump-spark ignition. If so desired a super compression can be obtained whereby the main compression begins, say, at 3 to 5 lb. above atmospheric pressure. This increases the capacity of the engine with a possible slight decrease in thermal economy.

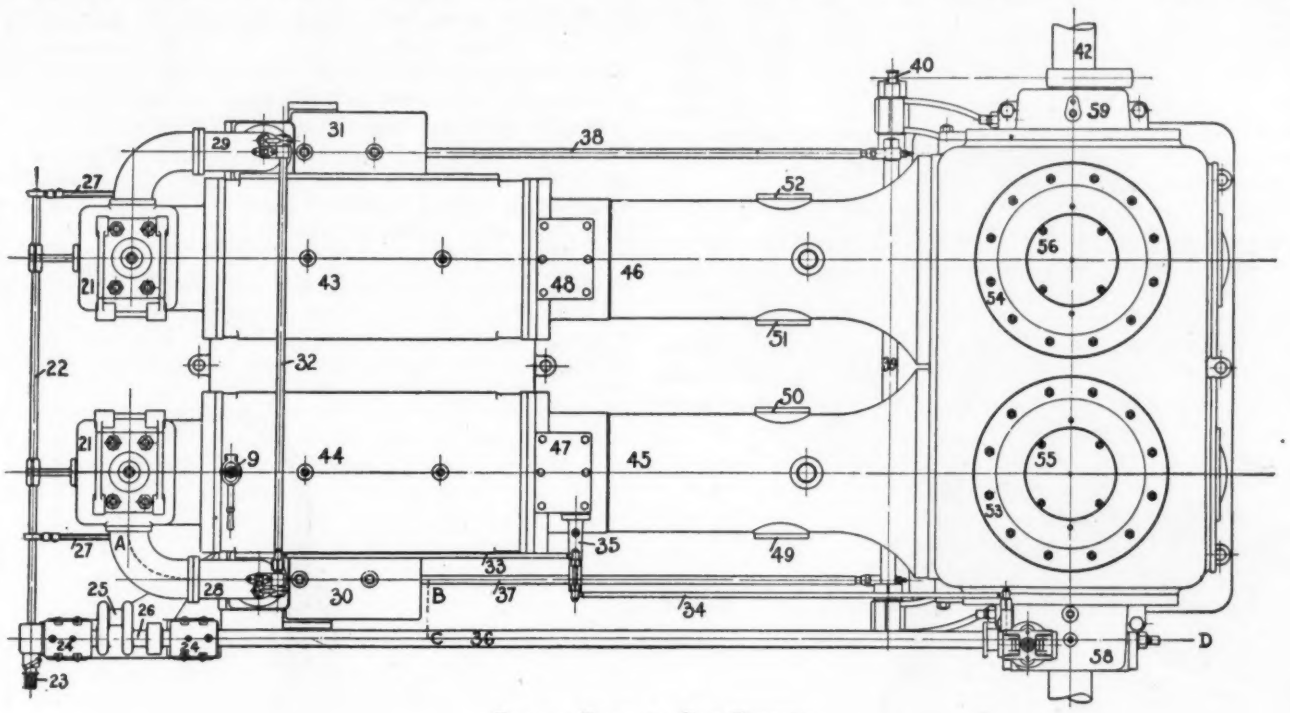


FIG. 2.—PLAN OF GAS ENGINE.

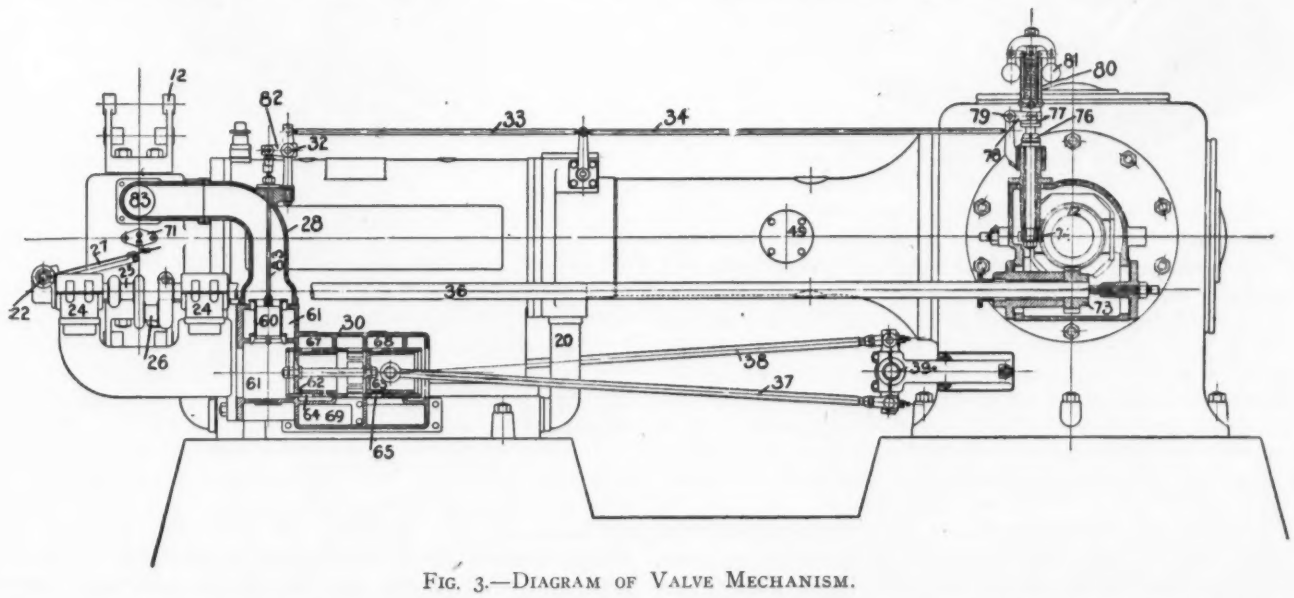


FIG. 3.—DIAGRAM OF VALVE MECHANISM.

It is claimed that an engine of about 75 hp with cylinders 9 in diameter by 12 in. stroke has been found by repeated tests to develop a mechanical efficiency over 85 per cent, the pump work being included as friction. The explanation for this is laid to the co-ordination of pump and motor cylinders, no loss of wire drawing through valves due to ample valve areas, the positive operation and balancing of all valves, absence of stuffing boxes, etc.

Portable Galvanometer Test Set.

The portable test set illustrated herewith is a type recently put on the market to meet the revised portable testing set specifications of the Navy Department, which have been altered considerably and made much more exacting than heretofore. The arrangement of this set has been made not only with these specifications in mind, but also with a view to securing the maximum portability with due regard to convenience in mechanical arrangement, while the connections of circuits are such that a large variety of tests beyond those indicated in the Government specifications may be executed. It is especially suitable for the use of telephone and telegraph companies, electric light and power stations and electrical engineers.

The set consists in general of a Wheatstone bridge with a 1, 10, 100 and 1,000-ohm coil in each arm. The rheostat consists of ten coils of units, tens, hundreds and thousand denominations, the last or tenth coil being added for convenience in checking up the next higher series of coils.

The bridge and rheostat are properly connected to a dead-beat D'Arsonval galvanometer of such high sensibility that a change of 1/10 of one per cent in the rheostat when measuring resistances of approximately 1,000 ohms value will give a decided galvanometer deflection. The needle is perfectly free from outside magnetic influence, and is so balanced that the test set can be used in practically any position; it is also provided with an adjustment lever so that the pointer of the galvanometer can be made to indicate zero.

PORTABLE TEST SET.

The battery consists of six chloride of silver cells, connected so that any one or number up to six in series may be used, while a pair of binding posts allow the use of an outside battery when desired.

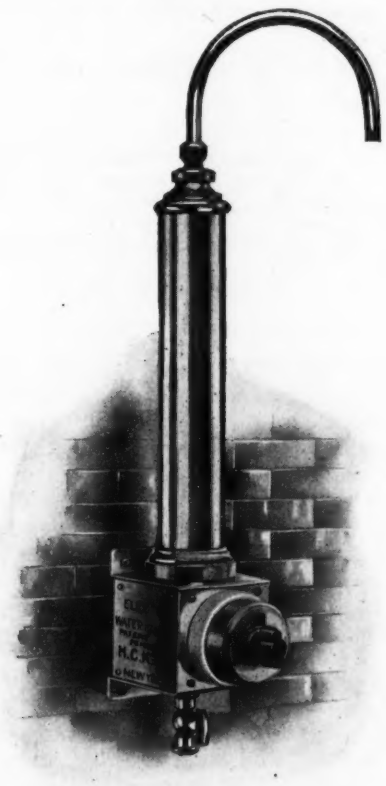
In addition to the usual measurements of resistance, this set can be used for locating grounds, crosses and other cable troubles utilizing either the Murray or the Varley loop tests, while it can be used for insulation resistance measurements and numerous other tests, such as checking up voltmeters and ammeters, measuring battery resistance, etc.

The over-all dimensions of the set are approximately 12 by 8 by 6 in., and the weight is about 12 lb.; the case is made of polished quartered oak, and is protected with nickel-plated brass corner pieces. The instrument is manufactured by Queen & Co., Inc., Philadelphia.

Instantaneous Electric Water Heater.

The H. C. K. Company has developed an electric water heater, shown herewith, in which there is direct contact between the water and heating element, and including an automatic cut-out which intrrupts the current when water ceases to flow, or when the flow is reduced to an extent that the water in the heater would boil. Insulating joints are provided at the top and bottom of the heater tube, and the resistance of the water is sufficiently great to prevent any flow of current. Where the heater is connected to the regular three-wire system, the neutral, or grounded connection, is connected to the lower part of the heater, which prevents any grounds, as there can be no difference of potential. This is also the case where the heater is used on alternating systems, where one side or the neutral of the secondary circuit is grounded.

The heater consists in the main of a supporting box, upon which is mounted a double pole quick-break switch, an insulating joint of special design to the lower end of which is attached a ¼-inch water valve. Screwed into the upper part of the insulating joint is a bronze fitting within which is placed the cut out which automatically opens and closes the electric circuit as the water is turned off and on. In the upper end of the bronze fitting, there is held, like a water glass for a boiler, a porcelain tube, with one terminal at each end. Within the porcelain tube is placed the heating element which consists of a spiral made of a material guaranteed not to rust or corrode, or be injured in any way by the action of the current. At the upper end of the porcelain tube, there is another bronze fitting with insulating joint above it which supports the spout. One wire leads from the switch to the upper bronze fitting on the porcelain tube, and the wire from the other side of the switch leads to the lower bronze fitting. The porcelain tube and the bronze fittings are surrounded by a brass tube, 1¾ in. in diameter. The total height of the heater from the bottom of the inlet valve to the top of the spout is 20 in., and all fittings are nickel plated and highly polished. The device is ornamental, and can be placed anywhere where an electric circuit can be installed. The heater can also be used in connection with a water tank, to be placed slightly above it, in which case it is not necessary to connect the heater with the water system, only connecting it to the electric wiring by means of



ELECTRIC WATER HEATER.

an attachment plug and flexible cable of the proper kind. Under this condition, the water heater is portable, and can be installed in any hotel room where it can be attached to the ordinary wash-stand.

If the water valve is open but the switch not turned on, cold water will flow from the heater. The moment the current is turned on the water becomes heated instantly, and by regulating the flow of the water the temperature can be adjusted up to 200° F.

The standard heater requires about 10 amperes at 110 volts, and will heat a glass full of water to 190° F. in 40 seconds, which at the rate of 10 cents per kw-hour would cost .014 cent. The same heater would heat 1 gallon of water to the same temperature in 10 minutes for less than 2 cents. For an ordinary wash-stand, there would be required about 1 quart of water at about 105° F. The heater would require 40 seconds to heat this water, and the cost would be less than .014 cent.

The HCK electric heater is made in several sizes, from 10 to 25 amperes at 110 volts, and 5 to 12 amperes at 220 volts, for either direct or alternating current of any frequency. The 10-ampere size will heat one glass of water to 190° F. in 40 seconds, and the 25-ampere size will heat one glass of water to the same temperature in 15 seconds. The 10 to 12-ampere, 110 volts size and 5 to 6 amperes on 220 volts is the standard for general service and heats one glass of water to 190° F. in 40 seconds. The heaters will be ready for delivery by October 15.

Commutating Pole Variable Speed Motors.

The exacting requirements of machine tool motor drives, hoist work and other classes of severe service have created a demand for a variable-speed electric motor. In order to meet these conditions and also to increase the output from a given motor frame, the General Electric Company is placing on the market a line of variable-speed commutating-pole motors.

As can be seen from the accompanying illustrations, Figs. 1 and 2, the commutating poles in these machines are placed between the main field poles and are so wound that they are excited by a portion of the main current. The main field poles are usually provided with an ordinary shunt winding, but they may also be compound-wound when service conditions require. The commutating poles provide a magnetic field of sufficient intensity to neutralize the effect of the current in the armature coils which are short-circuited during commutation. Sparkless commutation at all loads within the speed range specified is thus obtained. As the action of these poles is reversible the motors

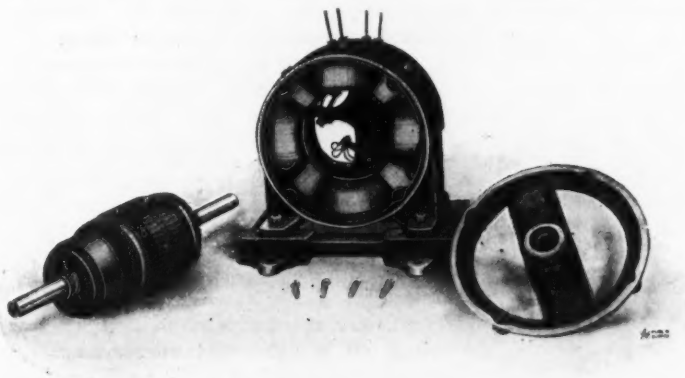


FIG. 1.—PARTS OF MOTOR.

can be run equally well in either direction. Not only does the addition of commutating poles improve the operating conditions of the motors, but the new machines can be operated at a higher output over a wider speed range, so that greater power is concentrated in a small size frame.

In the larger sizes the field frames are of cast iron, while in the smaller sizes they are built of steel. Both types of motors are so constructed that, by turning the bearing brackets through 90° or 180° relatively to the frame, the machines can be mounted on the wall or the ceiling. Where motors are used in places where flying particles or dirt are liable to injure the machine, the bearing brackets are fitted with perforated hand-hole covers, which furnish complete protection to the motor, and at the same time allow free circulation of air through the windings. Solid hand-hole covers can be supplied when it is necessary to totally enclose the motor; the capacity of motors under such circumstances, however, will be somewhat reduced owing to the decrease in ventilation.

The commutating pole type of motor is particularly suitable for individual variable-speed, machine-tool drive. It is small in

FIG. 2.—VIEW OF MOTOR.

diameter, comparatively short along the shaft and substantial in construction. The smaller sizes are well adapted for driving lathes as they can be mounted on the top, bottom or side of the driven machines. Similarly, the larger sizes are suitable for the larger classes of machine tool work as well as for ordinary commercial requirements. The smaller sizes vary from 5 hp to 20 hp. For heavier work the larger type is built in capacities up to and including 130 hp.

New Hydro-Electric Plant to Supply the City of Quebec, Canada.

An important addition to the developments of water powers, with which the Province of Quebec is well supplied, has been undertaken by the Quebec Railway, Light & Power Company. Up to the present time this company has derived power from the famous Montmorency Falls, but this has proved inadequate for present needs, especially in the winter season when the water is low. Additional power has, therefore, become necessary so that the present development will supply every-day requirements. The city of Quebec has apparently recovered all its old-time prosperity, and, with the arrival of the new Canadian Pacific express trains and the construction of the Grand Trunk Pacific, a large demand for additional power has set in.

Owing to the conformation of the banks it is impossible to increase the power at Montmorency itself, but half a mile above the falls the river lends itself admirably to further development, for it widens and forms a natural reservoir in which to store surplus water and to provide for the season of drought. The company has erected there, according to the plan of Mr. E. A. Evans, chief engineer and general manager, a dam 84 ft. high, the highest in Canada, for such a purpose. The dam is 67 ft. 4 in. wide at the base and 12 ft. wide at the crest, with a reservoir capacity of 52,000,000 cu. ft. of water.

The contract for the plant to develop this power has been awarded to Allis-Chalmers Company's Canadian representatives, Allis-Chalmers-Bullock, Ltd., Montreal, the only concern in Canada which builds both the electrical and the turbine ma-

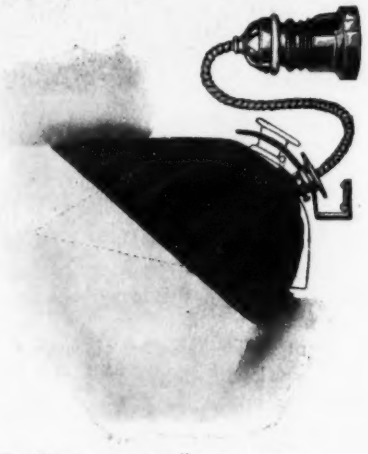
chinery for a hydro-electric development. The equipment to be furnished will consist of a 1,500-kw alternating-current generator, driven by a 2,225-hp turbine water wheel. The new power house is expected to be in operation early in December of this year.

The Quebec Railway, Light & Power Company has under consideration a further development at the Three Falls, two miles up the river, which, when developed, will provide for future demands for power.

"Poke Bonnet" Window Reflectors.

A new form of reflector has been introduced and widely used this year, known on account of its peculiar shape as the "Poke Bonnet" and made by the National X-Ray Reflector Company, of Chicago. This reflector was made especially for lighting show windows, pictures and art rooms. It is only fourteen inches long and each reflector uses two incandescent lamps horizontally, of any desired candle-power. The reflecting surface is not tin or plain glass, but instead the finest glass that can be blown, plated with pure sterling silver. This plating is backed with an elastic enamel, thoroughly protecting the reflecting surface under all conditions of temperature. The glass is corrugated scientifically, in order to diffuse the rays of light and provide against the faintest shadow of the bulb or filament.

It is said that sterling silver is the best reflecting surface known. Heretofore the trouble has been to use such reflecting



"POKE BONNET" REFLECTOR.

surface with economy, as exposure to the air has always tarnished it. But on account of the brilliance of the surface provided in the "Poke Bonnet" every ray of light is multiplied many times. For this reason three "Poke Bonnet" reflectors, using six incandescent lamps will, it is claimed, provide as much light for a window as the old-fashioned continuous trough with twelve lamps. Hence, the makers assert, the cost of lighting the windows brilliantly is greatly reduced, the saving in one window being sufficient to pay for the reflector in one year and save the same amount again.

These reflectors are carried in stock by electrical jobbers and a merchant is not obliged to wait to have his windows fitted with them. Each "Poke Bonnet" or section has a clever adjusting device so they can be set at an angle and quickly adjusted to concentrate the light on any particular point. They can be used in ordinary windows two or three feet apart, or if a great and increased amount of brilliancy is desired they may be set end to end.

Drumming up Detail Electrical Trade.

Mr. R. A. Shoenberg, of the Sarco Company, manufacturers of electrical specialties, New York City, has issued a characteristic circular as to the development of business, which embodies an excellent idea, and is produced almost in full below:

At the National Contractors' Convention, recently held at Cleveland, I chanced to meet a contractor who has two stores in London and a branch office in Paris. I happened to show him the new pendant switch manufactured by us, and he informed me that in London when an article of this kind is brought out on the market, the contractor gives each of his wiremen a sample to carry in his pocket, and when he goes out on a job, either to a private house, store or office, where they have electroliers, cluster lights, banquet lamps, brackets or chandeliers out of reach, the wireman is instructed to show the owner how easily the light can be controlled by a switch in circuit.

The average customer would be more interested in a suggestion from the wireman, who is a disinterested party, than from the boss, who is out to make his profit, the result being the wireman in some instances has sold as high as 12 or 15 pendant switches at a price ranging from $1.50 to $2.00 apiece, and the wireman gets the commission for the extra work received, which at the same time induces the wireman to keep his eyes open for other extra work.

I have mentioned the above method to several prominent members of the Contractors' Association here in New York and they have secured such very good results that I have decided to mention the matter to you, and should you try it and meet with success I would appreciate a line from you in regard to same.

Exhibits at the Ohio Convention.

The Ohio Electric Light Convention at Put-In-Bay, August 21 to 23, brought out an unusually good set of exhibits.

The Cleveland Window Glass Company exhibited one of its art glass domes.

The Pittsburg Transformer Company made an exhibit of transformers.

The Bullock Electric Manufacturing Company exhibited one of its induction motors.

The La Fayette Electrical Manufacturing Company exhibited Hornberger transformers.

The Simplex Heating Company had an exhibit of all the more common heating appliances.

The Wagner Electric Manufacturing Company made an exhibit of transformers and instruments.

The Electric Appliance Company, of Chicago, exhibited Sangamo wattmeters and Packard lamps.

The Phelps Company, of Detroit, had one of its large new flashers operating on the thermostat principle at work flashing a sign.

The H. W. Johns-Manville Company had a large display of enclosed fuse cut-out boxes for both high and low-tension circuits.

The Westinghouse companies made an exhibit of meters and arc lamps. The new Nernst series street lamp with vertical glower was one of the newest things in this exhibit. This can be operated on any standard alternating current arc circuit.

The General Electric Company had an electric kitchen outfit complete and also made an exhibit of high-efficiency carbon and tantalum filament lamps with reflectors. The "inverted bowl" reflector giving a wide, even distribution of light over a given area was the new feature of this exhibit.

"Brilliant" Lamps at the Ohio Convention

One of the attractive exhibits at the recent convention of the Ohio Electric Light Association at Put-In-Bay was that of the Brilliant Electric Company, of Cleveland. On, around and above a large table were shown Brilliant lamps of various kinds. In the center, mounted on an ornamental fixture, were tantalum lamps in frosted globes, at the base of which was a dazzling meridian cluster. On one end of the table was a group of Brilliant tipless lamps of various sizes, each lamp in a separate portable fixture. On the other end was a group of tipped lamps similarly displayed. Above the table was a row of the new Brilliant "Gems." As all lamps were lighted the effect was decidedly "brilliant." A feature which attracted much attention was a series of bulbs showing the various stages of lamp manufacture. A souvenir was distributed in the form of a tipless bulb with base attached and containing a cigar. The exhibit was in charge of Mr. E. J. Kular, manager of the company; Mr. E. V. Hennecke, representing the tantalum and "Gem" departments, and Mr. R. S. Jackson.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Reports indicate wholesome activity, with no evidence of reaction, even in those industries which are usually quiet at this season of the year. As the vacation season draws to an end there is a gradual resumption of idle machinery, and with the opening of many new furnaces all records of iron production will be surpassed in the fall. Pig has advanced again and the market has broadened, and the scarcity of iron for consumption this year is very marked. New business in steel rails is again coming forward, upward of 40,000 tons having been booked during the week. Structural material is in good request, and specifications are coming in freely, the principal one being for 34,000 tons for bridge work in New York. Retail trade is quiet, the time for shifting to fall displays having arrived, although some jobbers report reorders for summer goods in excess of supply. Crop reports are still favorable, a record yield of corn, a heavy spring-wheat outturn, and a cotton crop next to the largest ever gathered being in sight. Railway tonnage is of enormous volume, the record for August being the best ever attained in that period. Gross earnings for the first half of the month exceed those of a year ago, when trade was likewise active, by 16 per cent. Despite marked additions to equipment, a car shortage of more or less importance is not unlikely later on. Collections range from fair to good, with a slight tendency toward improvement. *Bradstreet's* reports 155 business failures during the week ending Aug. 23, as against 142 in the week previous and 176 in the corresponding week last year. Copper prices are firm and unchanged at 18¾@18⅞c. for lake, October shipment, and 18.55@18.80c. for electrolytic, October and November deliveries. Prime casting copper, thirty days, is 18.30@18.55c. These quotations are by producers for lots of 1,000,000 lbs. and more. Jobbers report active markets for lake at 19¼@19½c., and a great deal doing in casting grades at 18¾ @19¼c.

THE COPPER SITUATION.—An interesting review of the situation is given in the "Copper Gossip" of the National Conduit & Cable Company. It says: "The features of the copper situation are the strength of the market and the renewed demand from consumers. Apathy has been superseded by activity, and prices have not only held their own tenaciously, but the market seems to be in position to develop a stronger tone on the certainty of a big consumption for the balance of the year. Business has been transacted in good volume for domestic and foreign account, and it is understood that most of the output for August and September has been disposed of. Buying has extended to near the end of the year on requirements for fall manufacture, and consumers have orders in hand to insure active conditions right up to the close of 1906. The recent "bear" tactics by a concerted double movement in London and New York utterly failed to unsettle local values, and the manipulators for a reaction gave up the task as inopportune and hopeless. Consumption of all grades of copper is at too enormous a rate, and existing conditions of trade too overwhelmingly prosperous for the success of any scheme having as its object the promotion of an adverse sentiment. The high range of prices does not permit of any organized attempt to start a speculative "bull" movement in copper from the present level, and it is probable that the leading interests would not countenance an outburst of speculative activity, although the scarcity of stocks and the exceptional demand might furnish plausible reasons for a determined effort to put prices a few pegs higher. The growing demand from the copper and brass manufacturing industries for raw metal is forcing production to the utmost, and yet there is no serious accumulation of product discoverable at any point. Surplus stocks are almost next to nil in this country, and not equal to thirty days' requirements in Europe. At the same time, electrical developments are progressing at a rate that forces the question of adequate supplies to the forefront. Telephone and power transmission mileage is increasing so fast, and copper enters so largely into present building operations, and is being used on such an extensive scale, that the pressure of consumption is felt at every copper producing center of the globe as never before. The stupendous size of demand, and the multiplied indications that it is far from being an ephemeral demand, makes the outlook for the copper market and the manufactured products of this metal one of the most promising imaginable.

POWER FOR THE CITY OF MONTREAL.—The Montreal Light, Heat & Power Company has undertaken to develop the power at Soulanges Rapids so that the St. Lawrence River, 40 miles away, will be made to furnish power for the city's needs. The power house is being erected near lock No. 4 of the canal. This company has already accomplished much toward the harnessing of the neighboring waterways. It has drawn power from the Lachine Rapids, four or five miles away, the Chambly Rapids on the Richelieu, about 17 miles away, and the Shawinigan Falls on the St. Maurice, 86 miles distant. The development at Soulanges Rapids is the only plant of similar capacity and class so far designed and built on this continent. The contract for furnishing the hydraulic turbine and governing equipments was secured by the Canadian representatives of the Allis-Chalmers Company. The principal turbines, three in number, are each designed for a maximum capacity of 5,350 b.h.p.on the shaft, under head of 50 ft. Each machine will drive a 3,750-kw generator, direct coupled to it. The turbines will be equipped complete with self-contained oil governors for the purpose of securing the necessary speed regulation. There will be furnished, in addition to the main turbines, two smaller exciter units, each with a cacapacity of 300 hp and operating at a speed of 450 r.p.m. In laying out the power house, ample provision is being made for the addition of another turbine generating unit at some future time. A feature of the hydraulic construction is that used for the draft tubes for the larger units. This will be moulded in concrete, and it is said that this construction will be the first of the kind in Canada. The wheel chambers will be built in concrete and the roadway along the canal will pass over them. It is claimed that with concrete the necessary curves in the tubes can be made to cause less friction than with the ordinary steel or iron penstocks, and that great power can be developed from the given fall of the development. It is expected that the first main turbine and exciter will be delivered at the power house early in November. The chief engineer in charge of the plant is Mr. Wm. MacLea Wallbank.

LOCKE INSULATOR FACTORY.—The rapid expansion of the business of the Locke Insulator Manufacturing Company, of Victor, N. Y., has taxed to the utmost all the facilities of the old power plant, until, at the present time, the construction of a new and larger one has become imperative. The new building, for which foundations have already been laid, is to be 90 x 90 ft., of concrete construction; one side being parallel to and 15 ft. below the tracks of the New York Central & Hudson River Railroad, enabling hard and soft coal to be unloaded directly to the bunkers. The boiler room, which measures approximately 45 x 90 ft., will contain 600 horsepower in horizontal tubular boilers, hand fired with a mixture of buckwheat and soft coal, necessary draught being provided by a large engine-driven fan. Engines, generators and high-tension testing transformers will occupy the remainder of the building. There will be two power units, one for day load and a smaller one for night load, the demand for power being practically continuous. The smaller unit of 60 kw capacity is made up of a Skinner engine running at 300 r.p.m. direct conected to a 3-phase, 50-cycle, 440-volt alternator. The larger unit, a low-speed Corliss, will be direct connected to a 3-phase, 60-cycle, 440-volt alternator of 150 kw. These two machines will supply light and power, and current for testing all through the factory, as well as electrical energy for street and residence lighting in the village of Victor. The plant has been laid out for the most economical working under the peculiar conditions existing in an electrical porcelain pottery, and while the present plans as outlined will provide ample power for present needs, provision has also been made for the future.

ORDERS FOR STEAM TURBINES.—The July business of the Westinghouse Machine Company in the steam turbine department was double that for the same period of last year, orders having been taken for 16 units, aggregating a total of 40,000 horse-power.

CALL ROTARY ENGINE.—The Crescent Rotary Engine Co. has been formed at Spokane, Wash., by Mr. H. I. Call under his patents, and the engine has been reported on favorably by a committee of the local Chamber of Commerce. In this engine the cylinder is readily rotated by the pressure of steam against

the projecting ends of the sliding blades in the crescent-shaped steam chambers. As the cylinder revolves it constantly slides the blades back and forth through the arc-shaped slots holding them into the cylinder. The sliding movement of the blades corresponds with the pressure of the oval inner wall of the steam chest upon the points of the blades. When one end of the blade is passing the narrowest distance between the cylinder and the steam chest wall the other end is passing through the widest distance in the crescent-shaped steam chamber. The ends of the blades are fitted so tightly against the wall of the steam chest that not an atom can come between them. To reverse the engine, steam is admitted through opposite valves, the exhaust escaping through separate pipes. Mr. Call has completed two of the new model engines. One of them is running in his shop in Spokane. It shows remarkable strength, operating several large lathes, drills, saws and other heavy machinery. The engine is 6 x 7 x 11 inches, and occupies a floor space 15 x 20 inches with its fittings, with 14 inches to the top of the steam pipe and weighs 217 pounds. It was built with a steam expansion area for six horse-power, but Mr. Call states that he has developed 10 horse-power.

TELEPHONY IN NEW YORK.—Note was made last week of the fact that the Consolidated Telephone Company of Buffalo had purchased the franchise of the Great Eastern Telephone Company, which last winter, on the basis of an old charter of the New York Electric Lines Company, asked permission of the city to begin the laying of conduits and wires. Permission was denied on the ground that owing to the lapse of time the franchise had expired. At the same time another company known as the Atlantic Telephone Company was asking the city for a franchise for a telephone system to be operated in opposition to the New York Telephone Company and the New York & New Jersey Telephone Company, the subsidiaries of the American Telephone & Telegraph Company. Now that the franchise has gone to the Consolidated Telephone Company of Buffalo, it is possible that it will again become an active factor in the situation. The Consolidated controls a number of telephone companies in upper New York state, including the Frontier Telephone Company, which in 1905 had about 13,500 telephones outstanding. The stock of the Consolidated, of which there is $8,000,000 out of an authorized issue of $10,000,000 outstanding, receives no dividends. If it has secured a franchise for New York City under which it can actually operate, its position would be considerably strengthened. The Consolidated is understood to be backed by Buffalo interests and men in other cities of New York state who have a good deal of influence in state politics.

FRANK B. COOK, Chicago, has received a great number of orders for his protective telephone apparatus of various sorts. The largest part of his business consists in protection for switchboard, pole cable terminals, and subscriber's stations. A few of the orders he has recently received for these various types are as follows: Type L frame and protectors for Granite City, Ill.; Kirkwood, Mo.; Clayton, Mo.; Lexington, Neb.; Schoolcraft, Mich.; Boise City, Idaho; Seattle, Wash.; Seneca Falls, N. Y.; Delphi, Ind.; Akron, Ohio. He has also received from the War Department through some of the switchboard manufacturers, orders for fifty frames, equiped with protectors. For complete outside equipment or pole cable terminals, he has received among others, orders from the following places: Sussex, N. B.; El Paso, Tex.; Concordia, Kan.; Sullivan, Ill.; Franklin, Pa.; Charleston, Mo.; Marion, Ohio; Little Rock, Ark. For subscriber's station protectors the following orders have come in: Paris, Ill.; Quincy, Ill.; St. Louis, Mo.; Brockport, N. Y.; Atlanta, Ga.; Sussex, N. B.; Terre Haute, Ind. Mr. Cook says he is also doing more business than he can handle on Universal guy lamps and self-welding wire joints.

J. G. WHITE & CO. are said to have on hand contracts for construction work amounting to twenty millions. They include steam railroads, electric railways, power houses, harbor works, etc., as follows: steam railroads, $12,780,000; electric railways, $4,797,000; miscellaneous, $2,862,000; total, $20,439,000. The largest of the steam railroad contracts is that for the building of certain roads in the Philippines. The most important electric railway contract is that for the construction of the Buffalo, Lockport & Rochester Railway, valued at $1,800,000. Other important contracts are $1,315,000 for the reconstruction and extension of the Eastern Pennsylvania Railways Co., and $712,000 for the electrification of the Newton & Northwestern Railway, in Iowa, with the construction of an additional line to form the new system to be known as the Fort Dodge, Des Moines & Southern Railway.

THE DE LA VERGNE MACHINE COMPANY, East 138th street, New York, reports the following among other recent orders received for "Hornsby-Akroyd" oil engines: Central New England Ry. Co., Hartford, Conn., 7 hp geared to pump; F. J. Stokes Machine Co., Philadelphia, Pa., 25 hp; the Hastings Pavement Co., New York City, 16 hp; the W. F. Norman Sheet Metal Mfg. Co., Nevada, Mo., 50 hp; Union Ballast Co., New York City, one 20 hp and one 32 hp; D. P. Forst & Co., Trenton, N. J., 13 hp; Webb Wire Works, New Brunswick, N. J., 32 hp; Messrs. J. W. Lippincott, S. P. Scott and Max Meyer, Little Rock, Ark., 50-hp engine to drive a De La Vergne ice machine.

PLANT FOR LOGAN, O.—The city of Logan, O., is in the market for an electric light plant, including one horizontal 150-hp boiler, two 120-hp steam or gas engines and two 80-kw generators, etc. Mr. George Champe, Toledo, O., is engineer in charge of the work.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was increased activity and interest in the stock market, which, however, receded somewhat toward the end of the week on the hardening of money. Renewed support was shown in the prominent stocks, and public participation was on an increased scale. Throughout the list general advances were made, though in a somewhat irregular fashion as regards specialties. Electric and traction stocks closed at or near the highest quotations of the week on limited trading. Allis-Chalmers common closed at 20 and preferred at 49, net gains of 2 points and ½ point, respectively. General Electric lost 1⅜ points, closing at 169. This stock touched 171½ during the week, the lowest quotation in that period being 167. Westinghouse common suffered a drop of 5 points net, closing at 150. The closing quotation of American Locomotive common was 71 and of preferred 113. Little business was done in Brooklyn Rapid Transit, which is usually an active stock, the closing quotation being 77½, a net decline of ¼ point. Interborough-Metropolitan, both common and preferred, are higher, the former closing at 39¾ and the latter at 80¼, these quotations representing net advances of 2¼ and 1¾ points, respectively. Metropolitan Street Railway closed at 106, a decline of 2 points. Western Union declined 1 point, closing at 91¼. Other closing prices follow: American District Telegraph, 25; American Telegraph & Cable, 88; American Telephone & Telegraph, 125; Central & South American Telegraph, 140; Electric Storage Battery, 80 asked; Michigan State Telephone, 50; do preferred, 93; New York & New Jersey Telephone, 125; Havana Electric Railway, 45; do preferred, 80. The curb market was a little more active during the week, but net changes compared with a week ago were trifling, in most cases. Early in the week there was a gradual setback, followed by a partial recovery. A few stocks, such as Chicago Subway, were largely dealt in, and ended the week firm, that issue rising 5 points, on 65,000 shares. Most stocks of low denomination, because of the high transfer tax, were dull and neglected. Following are the closing quotations of Aug. 28:

NEW YORK

	Aug. 21	Aug. 28		Aug. 21	Aug. 28
Allis-Chalmers Co.	19⅜	19¾	General Electric	169	167
Allis-Chalmers Co. pfd.	48¼	48⅜	Hudson River Tel.	...	...
American Dist. Tel.	25	25	Interborough Rap. Tran.	...	...
American Locomotive	69¾	70⅛	Mackay Cos.	74⅛	73¾
American Locomotive pfd.	112	112	Mackay Cos pfd.	73	72
American Tel. & Cable	88	88	Marconi Tel.	42	42
American Tel. & Tel.	125	125	Metropolitan St. Ry.	106	...
Brooklyn Rapid Transit.	78	75	N. Y. & N. J. Tel.	...	...
Electric Boat	18	20	Western Union Tel.	91¾	91¼
Electric Boat pfd	60	60	Westinghouse com.	150	145
Electric Vehicle	10	13	Westinghouse pfd.	...	...
Electric Vehicle pfd.	10	17			

BOSTON

	Aug. 21	Aug. 28		Aug. 21	Aug. 28
American Tel. & Tel.	133¼	133⅛	Mass. Elec. Ry. pfd	72	70⅛
Cumberland Telephone.	116⅞	117	Mexican Telephone	...	...
Edison Elec. Illum.	...	...	New England Telephone	130¼	130
General Electric	...	...	Western Tel. & Tel.	...	11
Mass. Elec. Ry.	...	20⅛	Western Tel. & Tel pfd.	85¼	87

PHILADELPHIA

	Aug. 21	Aug. 28		Aug. 21	Aug. 28
American Railways	53⅛	53⅛	Phila. Electric	8⅜	8¼
Elec. Co. of America	11⅛	11	Phila. Rapid Trans.	30⅛	29
Elec. Storage Battery	73	70	Phila. Traction	...	99
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Aug. 21	Aug. 28		Aug. 21	Aug. 28
Chicago City Ry.	160	160	National Carbon	83	85
Chicago Edison	...	...	National Carbon pfd.	119	119
Chicago Subway	54	...	Union Traction	...	...
Chicago Tel. Co.	120	...	Union Traction pfd	...	...
Metropolitan Elev. com.	27¼	28			

KENTUCKY ELECTRICAL COMPANY.—Mr. Lawrence Jones has bought the lighting franchise at Louisville, Ky., for $100,150 after spirited bidding by Mr. E. G. Cowdry, representing St. Louis interests. Mr. Jones says: "We mean to go right along with the work of preparing to furnish Louisville with electricity. If I was not in earnest I would not have bid the amount I did for the franchise. The sale has to be approved by the Board of Public Works and then by the General Council. I am confident that the sale will be approved. The mayor is thoroughly satisfied with the result of the sale of the franchise and I think he has confidence in the purchasers so far as complying with the ordinance is concerned. Our hands are clean and we mean to deal fairly and squarely with the people of Louisville. The persons interested have been in conference lately and we have about decided to call our company the 'Kentucky Electrical Company.' We will be ready with the $50,000 bond as a guarantee and the $100,150 franchise money just as soon as the sale is approved and all litigation as to the validity of the ordinance has been wiped out. I am assured by the city authorities that they will give us clear sailing so far as validity of the ordinance and the legality of the franchise are concerned. We will build a plant of sufficient capacity to make good our promise to the citizens of Louisville. The company will be incorporated in time to comply with the provisions of the ordinance. Articles of incorporation will probably be filed within the next week. However, that is a small matter. What we want now is a clear field."

MASSACHUSETTS LIGHTING.—The Massachusetts Board of Gas and Electric Light Commissioners has given its approval of issues of additional capital stock by the Beverly Gas & Electric Company, the Chicopee Gas Light Company, and the Lawrence Gas Company. The Beverly Gas & Electric Company is allowed to issue 919 additional shares at a par value of $100. The company petitioned for an issue of 2,000 shares, but in the opinion of the board 919 shares seemed sufficient. The proceeds of this issue are to be used for the payment of costs of additions made to the company's plant. The Lawrence Gas Company is allowed to issue 4,000 shares at the par value of $100 each, the proceeds of this issue to be used for the payment of the cost of additions made to the plant. The Chicopee Gas Light Company, which petitioned for approval of an issue of $75,000 additional capital stock, is allowed to issue 500 shares at par, the proceeds to be used for the payment of floating indebtedness, and 240 shares, also at par value, the proceeds to be used for payment of costs of additions to the plant.

CINCINNATI LIGHTING PLANS.—It is announced from Cincinnati that a lease for ninety-nine years of the Cincinnati gas and electric plant was signed here on August 23, placing it in the hands of the Union Gas & Electric Company. A. S. White, C. A. Lieb, J. J. Rollins, of New York, and R. W. White, of Cleveland, represent the new company. The leasing company puts up a deposit of $3,000,000 as a guarantee of dividends to the old stockholders. The capitalization is $20,000,000, half preferred at 6 per cent and half common. It is expected that Norman Kenan, president of the old company, will be elected to a similar position in the new corporation. It is said that the new company, which will succeed to a monopoly of the lighting business in this city, will spend large sums in the improvement of its property. The contract is said to contain a stipulation that $2,000,000 is to be spent in the next five years on the development of the property.

WESTERN POWER COMPANY.—Articles of incorporation of the Western Power Company have been filed in Jersey City, N. J. The capital is $18,000,000. The company has been organized to buy stocks, bonds, or evidences of indebtedness issued by corporations and to manage such corporations. Harry P. Wilson, Adrian H. Larkin, and Augustus C. Doan, all of 243 Washington street, Jersey City, which is the office of the New Jersey Trust Corporation, are named as incorporators. Adrian H. Larkin, of the law firm of Joline, Larkin & Rathbone, is a director in several coal and railroad companies in Pennsylvania and secretary of the Pressed Steel Car Company and the Western Steel Car & Foundry Company. He is also secretary of the Norfolk & Southern Railroad Company and a director of the Texas Transport & Terminal Company.

DIVIDENDS.—Galveston Electric Company semi-annual of $3 per share on the preferred has been declared payable Sept. 1 to stockholders of record Aug. 22. Cape Breton Electric Company, Limited, initial semi-annual of $3 per share on preferred stock, payable Nov. 1 to stockholders of record Oct. 16 has been declared. The directors of the Colorado Telephone Company have declared a quarterly dividend of 1¾ per cent. This is an increase from 1½ per cent, and puts the stock on a 7 per cent basis. The dividend is payable October 15.

EARNINGS IN TOLEDO.—The Toledo Railways & Light reports for July and seven months as follows:

	1906.	1905.	1904.
July gross	$180,969	$171,994	$158,377
Expenses and taxes	89,646	84,873	77,820
July net	$91,323	$87,121	$80,557
Charges	42,785	43,106	41,186
July surplus	$48,538	$44,015	$39,371
Seven months' gross	1,143,471	1,067,788	984,236
Expenses and taxation	598,492	548,610	534,784
Seven months' net	$544,979	$519,178	$449,452
Charges	296,506	296,921	291,535
Seven months' surplus	$248,473	$222,257	$157,917

CHICAGO ELEVATED ELECTRIC.—The Metropolitan West Side Elevated at Chicago has issued its report for the year ended June 30, which compares as follows:

	1906.	1905.	1904.
Gross	$2,530,279	$2,224,968	$2,169,211
Expenses	1,208,287	1,112,736	1,020,280
Net	$1,321,992	$1,112,232	$1,148,931
Other income	11,997	7,193	8,904
Total merchandise	$1,333,989	$1,119,425	$1,157,835
Charges	975,479	889,283	861,821
Surplus	*$358,510	$230,142	$296,014

*Equal to 4.11% on preferred stock.

RICHMOND, VA., EARNINGS.—The annual report of the Richmond Light & Railroad Company for the year ending June 30 shows as follows:

	1906.	1905.	1904.	1903.
Gross	252,328	219,955	222,332	164,084
Expenses	225,960	246,390	209,589	130,972
Net	26,368	†26,435	12,743	33,112
Other income	4,426	109,398	107,602	72,903
Gross income	30,794	82,963	120,345	106,015
Charges	108,000	108,000	108,000	104,666
Deficit	77,206	25,037	*12,345	*1,349

*Surplus. †Deficit.

THE TELELECTRIC COMPANY.—Although plans have not been fully completed as yet, it can be said that all of the money necessary to enlarge and conduct the business of the Telelectric Company has been arranged for and new blood will be infused in the directorate. The company is capitalized at $400,000, but no increase is planned at this time. John F. Kelly, president of the Telelectric Company, will probably continue the active management of the concern, whose very ingenious electric piano player has been described in these pages.

GALVESTON ELECTRIC REPORT.—The Galveston Electric Company reports earnings as follows for the month of June and the year ended June 30:

	1906.	1905.	Changes.
June gross	$32,165	$25,195	Inc. $6,970
June net	15,754	10,958	Inc. 4,796
Surplus over charges	11,587	6,791	Inc. 4,796
Twelve months gross	286,613	258,578	Inc. 28,035
Twelve months net	107,017	68,418	Inc. 38,599
Surplus over charges	57,017	....	....
Construction charges June, 1906			$3,367
Construction charges 12 months ending June 30, 1906			38,041

NEW ORLEANS EARNINGS.—The New Orleans Railway & Light Company reports earnings for the month of July and for seven months as follows:

	July.	Seven months.
Gross	$443,831	$3,342,919
Expenses	264,685	1,805,153
Net	$179,146	$1,537,766
Interest, taxes and miscellaneous charges	161,450	1,077,736
Surplus	$17,696	$460,030

BOSTON EDISON GROWTH.—The Edison Company of Boston for July showed an increased business of 22,000 16-candle-power equivalents, against an increase for July, 1905, of 15,000 16-candle-power equivalents. The company has closed a contract to supply the electric lighting and electric power for the new National Shawmut Bank building, requiring about 4,000 lights.

CINCINNATI LIGHTING.—The Union Gas & Electric Company, lessee of the Cincinnati Gas & Electric Company, has increased its capital from $10,000,000 to $20,000,000. It is understood that $10,000,000 6 per cent preferred stock will be sold immediately.

NORTHWESTERN TELEPHONE STOCK.—The Northwestern Telephone Company, Minneapolis, will issue $5,000,000 new stock, increasing its capital from $10,000,000 to $15,000,000, to provide for the extension of lines through Minnesota and the Dakotas.

BELL STOCKHOLDERS.—There has been a remarkable increase in the list of stockholders in the American Telephone & Telegraph Company, from 10,790 on January 1, 1903, to 17,556 on January 1, 1906.

GENERAL NEWS.

Construction News.

BIRMINGHAM, ALA.—John Towers, J. H. McCary and several other prominent citizens are considering a proposition to build a 5-mile scenic road along the crest of Shades Mountain.

JACKSONVILLE, ALA.—Ludwig & Company, of Atlanta, Ga., are the consulting and supervising engineers for the new electric lighting plant, not the contractors, as reported recently in these columns.

PRESCOTT, ARIZ.—The Council has accepted the proposition of the merchants to advance the money to purchase the equipment to deliver electricity to the business district of the city.

ARGENTA, ARK.—John C. Vogel has secured a franchise for an electric light and power plant.

BLACK DIAMOND, CAL.—The question of issuing $34,000 in bonds, part of which will be used for water works and an electric light plant, is under consideration.

MARTINEZ, CAL.—An electric railway to connect the town of Black Diamond with the Bowers Rubber Works and the railway station is projected by C. A. Hooper & Co., of Black Diamond.

NAPA, CAL.—Preliminary steps are under way for the construction of a new electric railway to be built by the Bay County Railway Company from this city to San Francisco, a distance of 45 miles.

REDWOOD CITY, CAL.—William H. H. Hart has petitioned the Town Trustees for a franchise to construct an electric railway through this city. The proposed road is to run from Pacific Grove to San Francisco.

SAN FRANCISCO, CAL.—It is stated that plans are now being made by the Southern Pacific Company to convert its entire Alameda local train service into an electric system, and to extend the system to Oakland over new lines.

REDDING, CAL.—Henry L. Shannon has appropriated 10,000 miners' inches of water from a creek in this vicinity for generating electricity; also 5,000 inches from Snow Creek to be used in the Shasta Power Company's hydro-electric plant.

OROVILLE, CAL.—E. J. Mitchell, city clerk, writes that the city trustees are considering the question of municipal ownership of its water light and gas. The first step the city expects to take is the employment of an engineer to ascertain the most feasible plan, and the total cost of same complete.

OROVILLE, CAL.—It is reported that the Western Power Company will soon go ahead with its work. Guy C. Earl, of Oakland, who is largely interested in the company, and M. A. Viele, an engineer, of New York, has been in this city in the interests of the project. The company owns a large reservoir site at Prattville. In addition it owns the Big Bend tunnel and recently purchased the rights of the Golden State Power Company. About 300,000 hp can be developed. The company is capitalized at $50,000,000. It is believed the first work will be done at the Big Bend, and it is reported that work on a 40,000-hp plant will be begun soon.

DURANGO, COL.—The Standard Light & Power Company has purchased the plant of the Durango Light & Power Company. The Standard Company is said to have decided to construct a new plant to be run by water power, the water to be taken from Junction and Hermosa Creeks. The probable cost of new plant is $250,000.

JEWETT CITY, CONN.—At a meeting held Aug. 22, it was decided to instruct the electric light committee to obtain estimates on the cost of a new engine of 125 hp to replace the one now needing repairs; also the cost of a new 85-kw dynamo, and report at the meeting to be held Aug. 29.

DANIELSON, CONN.—The Borough of Danielson has entered into a contract with the People's Light & Power Company for street lighting for a term of five years. The company is to furnish not less than 22 arc lamps at $72 per lamp per year, and 64 incandescent lamps at $15 each per year. The company will replace the present arc lighting system with new enclosed arc lamps at a cost of nearly $3,000.

WASHINGTON, D. C.—Bids will be received until Sept. 18 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the Navy Yards, at Mare Island, Cal., and Puget Sound, Wash., a quantity of naval supplies as follows: Schedule 110—Transformers, conduits, cable, blower and motor, drill steels, etc. Applications for proposals should designate the schedule desired by number. H. T. B. Harris, Paymaster-General, U. S. N.

PENSACOLA, FLA.—An application has been made to the City Council for a franchise for a new street railway. The applicants are A. A. Ericson and a number of Alabamians, together with other capitalists, who are owners of the Beach Haven property, on Little Bayou, west of the city.

CORDELE, GA.—The Citizens Electric Light & Power Company is installing an additional boiler in its power house in this city. The company will soon establish a day service.

PAYETTE, IDA.—The Idaho Light & Power Company will commence work on the construction of its plant about Oct. 1. H. Newell is general manager.

PINKEYVILLE, ILL.—A company has been organized for the purpose of constructing an electric lighting plant in the town. It is expected to have the plant in operation by December, 1906.

CHICAGO, ILL.—President McCormick has been instructed by the drainage board to execute a contract with the West Chicago park comsioners to furnish electricity to west side parks as soon as the power plant at Lockport is in operation. The contract is for a term of 15 years and provides that the park board shall consume a maximum of 1,500 hp and a minimum of 800 hp.

VINCENNES, IND.—A franchise has been granted by the City Council to the Indianapolis, Vincennes & Evansville Traction Company to use certain streets in the city.

MADISON, IND.—Capitalists in this city have taken steps to organize a company to construct an electric railway from Madison to Scottburg, a distance of 40 miles, to connect with the Indianapolis & Louisville line.

DAVIS, I. T.—Work will soon commence on the construction of the new electric lighting plant in this place.

CHICKASHA, I. T.—Work will commence on the construction of the new power plant of the Chickasha Water Power Company in about 60 days. C. E. Ross is secretary and manager.

MUSKOGEE, I. T.—The Muskogee Electric Traction Company will make immediate improvements to its system. Among the improvements proposed are a new power plant, at a cost of $75,000, and a new car barn.

BELLEVILLE, KAN.—The citizens have voted to issue $20,000 in bonds for an electric light plant.

SOLOMON, KAN.—The question of constructing water works and an electric light plant is under consideration here.

WELLINGTON, KAN.—It is stated that an election will probably soon be held to vote on issuing $50,000 in bonds for water works and an electric light plant.

FORT LEAVENWORTH, KAN.—Sealed proposals will be received until Sept. 19 by Captain J. E. Normoyle, quartermaster, for furnishing and installing a complete electric fire alarm system at Fort Leavenworth. Full information and blank forms of proposal furnished on application at this office, where plans and specifications may be seen.

COTTONWOOD FALLS, KAN.—The Missouri & Kansas Telephone Company has purchased the system of the Chase County Telephone company. The new owners will begin at once the reconstruction of the entire system. An expenditure of from $12,000 to $15,000 is contemplated.

FORT SCOTT, KAN.—The Fort Scott Gas & Electric Company, of this city, in addition to owning and operating the street railway system of the city, is now dealing in electrical and gas supplies, electric fans, motors, etc. The officers of this enterprise are: Grant Hornaday, president; C. F. Martin, vice-president; F. A. Hornaday, secretary; and F. D. Martin, treasurer and superintendent.

FRANKFORT, KY.—The Central Kentucky Traction Company is contemplating the construction of a new power house.

COVINGTON, KY.—The Council has accepted the plans for the proposed municipal electric light plant, prepared by Owen Ford, St. Louis, Mo. The probable cost is $106,000.

MAYFIELD, KY.—The Mayfield Water & Light Company is contemplating extensive improvements and increasing the capacity of its plant. A new power house will be erected and a 400 or 500-kw, direct-connected unit installed. J. W. Landrum is secretary and manager.

LOUISVILLE, KY.—The lighting franchise, as provided under what is known as the Atherton-Jones ordinance, was sold at public auction Aug. 18 to Lawrence Jones, for $100,500. It is stated that the new company will soon be incorporated under the name of the Kentucky Electrical Company and will commence the construction of its plant as soon as the sale of the franchise is approved and all litigation as to the validity of the ordinance has been wiped out.

CROWLEY, LA.—The Westinghouse Electric Company, of New Orleans, has secured the contract for a 4,000-light dynamo for the municipal electric light plant for $3,200.

NATCHITOCHES, LA.—Extensive improvements and additions will be made to the municipal electric light and water works plant in the near future. A 150-kw, alternating-current, three-phase, 2,300-volt Crocker-Wheeler generator direct connected to a 220-hp Harrisburg engine will be installed about Oct. 15. J. R. Carroll is superintendent.

MILO, ME.—The Milo Electric Light & Power Company has awarded the contract for the construction of its new power station to Fred W. Bolster.

TAUNTON, MASS.—Both brnches of the city government have adopted the order for an appropriation of $12,000 for additional street lights.

WORCESTER, MASS.—E. J. Cross, of this city, has secured the contract for the construction of a power house for W. H. Leland & Co., for $2,000.

BEVERLY, MASS.—The Beverly Gas & Electric Company has been authorized by the Board of Gas and Electric Light Commissioners to issue $200,000 of new stock for additions to plant subsequent to May 31, 1906.

BOSTON, MASS.—A franchise has been granted by the Metropolitan Park Commission to the Boston & Northern Street Railway for the proposed electric railway from Stoneham to the lines of the Boston Elevated in Medford, through the Middlesex Falls Reservation.

SPRINGFIELD, MASS.—The Springfield & Eastern Street Railway Company has filed with the Railroad Commission petitions for the approval of locations granted by local authorities for the construction of a connecting line with the Worcester & Southbridge Street Railway.

WARE, MASS.—Improvements are being made at the power house of the Ware Electric Company preparatory to the starting of a day service in September. The company is also extending its lines to Ware Center to establish the street lighting service, which was voted for last March.

LAWRENCE, MASS.—The Lawrence Gas Company has been authorized by the Board of Gas and Electric Light Commissioners to increase its capital stock from $1,000,000 to $1,400,000, the proceeds to be applied to the payments and cancellation of obligations of the company existing on June 30, 1906.

WORCESTER, MASS.—The Board of Gas and Electric Light Commissioners has authorized the Worcester Electric Light Company to issue 2,000 additional shares of capital stock at $160 per share. The proceeds of 1,400 shares are to be applied to the payment of additional underground conduits and cables, and the proceeds of 600 shares to other additions to the plant.

OWOSSO, MICH.—The Council has granted J. A. Thick, of Detroit, a 30-year electric street railway franchise.

ELKHART, MICH.—A franchise has been granted to the Elkhart, Three Rivers & Kalamazoo Railway Company by the city of Elkhart. It is stated that nearly all the right of way has been secured from Three Rivers to Kalamazoo, and that work will soon commence on the construction of the road.

STANDISH, MICH.—The Flint Land & Improvement Company has commenced work on the construction of a large dam on the Rifle River, north of this place, being the first one of several the company contemplates building for furnishing electricity for lighting the towns along the Michigan Central and shore towns and power for operating manufacturing plants. An electric belt railway is also planned to encircle the county with headquarters at Standish.

EVELETH, MINN.—S. S. Hough has petitioned the City Council for a franchise to establish an electric light plant in this city.

MINNEAPOLIS, MINN.—At a meeting of the board of directors of the Northwestern Telephone Company, held Aug. 7, it was voted to increase the capital stock from $6,000,000 to $15,000,000.

NASHWAUK, MINN.—The contract for the construction of the municipal electric light plant has been awarded to the Burgess Electric Company, of Duluth. Work will commence on the plant about Sept. 1, and is to be completed by Oct. 15. The equipment for the plant will consist of one 50-kw, direct-current Westinghouse generator, an Ideal engine of 85-hp and a 100-hp boiler. John H. Carlson is village clerk.

SHAW, MISS.—Work has commenced on the construction of the new municipal electric lighting plant for the town. The contract for the work has been awarded to the Sanders Johnson Company, of Vicksburg. The equipment of the plant will consist of a 75-kw General Electric three-phase, 60-cycle, 2,300-volt alternator, a 100-hp Ide engine and two boilers made by the Atlas Company. S. B. Clark is chief engineer.

NEVADA, MO.—Thomas H. McDonough, promoter of the Kansas City, Nevada & Springfield Railroad, announces that the money has been secured to build the road and that it will be built as originally planned, except that it will be operated by electricity instead of steam.

ST. LOUIS, MO.—Two lighting contracts for the illumination of the city buildings were let at the meeting of the Board of Public Improvements, Aug. 17. The Union Electric Light & Power Company was awarded the contract for lighting south of Washington Avenue at 4½ cents per kw-hour, the Laclede Power Company secured the lighting north of Washington Avenue at 5 cents per kw-hour. Neither of the companies had competition and despite this fact the Union Electric Light and Power Company put in a bid lower than the one of last year. This year's contract under the lowest bid will save the city $1,100. The present lighting contract for city buildings expires on Aug. 31, and the new contracts will go into effect in September.

PLAINS, MONT.—Hibler & Company have secured a franchise for an electric light plant.

MILES CITY, MONT.—J. E. Farnum, city clerk, writes the citizens voted July 30 to issue $10,000 bonds to be used for the enlargement of the city electric light plant.

FREMONT, NEB.—This city will shortly vote on the proposition of issuing $50,000 in electric light bonds. The proceeds will be used for improving the municipal electric lighting plant.

FT. OMAHA, NEB.—Bids will be received until Sept. 10 by Maj. M. Gray Zalinski, Constructing Quartermaster, U. S. A., Army Building, Omaha, for furnishing and installing transformer, service wires and watt meter for electric lighting post exchange and gymnasium at Fort Omaha.

LEBANON, N. H.—The new power station of the Lebanon Electric Light & Power Company is nearly completed and is expected to be in operation in October. A new dynamo of 4,000 light capacity and a new engine is to be installed. A day power service will be established as soon as the plant is completed. It is stated that the company will build an addition to the power house next year and install another dynamo of the same capacity and an additional boiler. H. M. Tucker is superintendent.

BRADLEY BEACH, N. J.—The property owners have decided to petition Council to install water works and an electric light plant.

NEWARK, N. J.—The City Hall Commission has made an agreement with the United Electric Company of New Jersey, whereby the company is to furnish electricity to the new building for an indeterminate period, the agreement to end at the pleasure of the commission. The energy is to be supplied at a rate of 5 cents per kw-hour.

ORANGE, N. J.—Mayor Isaac Shoenthal, of Orange, on Aug. 21, signed the two resolutions recently passed by Council providing for establishing a lighting plant in connection with the water pumping station in Chestnut Street, and engaging James M. Seymour, Jr., as engineer. Mr. Seymour is now at work on plans and expects to submit them with specifications to the Council about Sept. 10. Bids for construction will probably be received about Oct. 1.

WEST POINT, N. Y.—Bids will be received by the Quartermaster, U. S. M. A., until Sept. 22 for the construction of an electrical subway system.

UTICA, N. Y.—The Hudson River Electric Power Company has made application for a franchise in this city. The company wishes to bid for the street lighting contract, which expires January 1.

GENEVA, N. Y.—Newton S. Page, highway commissioner of the town of Geneva, has granted the request from the Geneva, Phelps & Newark Railroad Company for permission to operate its proposed electric road across the highways in the town.

CORNING, N. Y.—Bids will be received until Sept. 5 by the Board of Water Commissioners, for two gas engines of 150-hp each, with gas producer plant for same, and two triplex power pumps of 2,000,000 gallons daily capacity each. W. J. Heermans is secretary.

AMSTERDAM, N. Y.—At a meeting of the stockholders of the Empire State Power Company, held Aug. 21, it was decided to amend its articles of incorporation so that the company may extend its operation to several additional counties. C. H. Parson is president.

BERGEN, N. Y.—The Genesee Power Company has made a proposition to the Business Men's Association of Bergen, to tap the line of the Niagara, Lockport & Ontario Power Company at the West Shore, a mile north, and erect a $10,000 station and transformer, for the purpose of furnishing the village with electricity for power and light.

UTICA, N. Y.—Arrangements are now being made by the Hudson River Power Company for the commencement of the work on the tower from the company's plant in this city to Clarks Mills, for the transmission of electricity for the West Shore line from Utica to Syracuse. The enlargement of the local plant to meet the additional demands that will be made upon it, is now under way. Charles E. Parsons is chief engineer.

NEW YORK, N. Y.—The Consolidated Telephone Company, of Buffalo, has purchased from the Great Eastern Telephone Company its franchise to maintain and construct telephone, telegraph lines and electric lamps in New York City. A syndicate is to be formed to take the franchise, and an operating company will be formed later to operate an independent telephone system in New York in connection with the independent companies controlled by the Consolidated Company.

ROCHESTER, N. Y.—The only bid received on Aug. 22 by the Board of Contract and Supply for lighting the city was submitted by the Rochester Railway & Light Company. By the terms of the bid the price per arc lamp will be reduced from $78.50 per year to $57.95, a saving of $21.55 on each lamp. Incandescent lamps of 32 cp will be furnished for $19.36 per lamp per year. The arc lamps that are fed by underground cables the company agrees to furnish for $68 per lamp per year. For pairs of arc lamps the rate will be $62.96 per year. As the new contract will apply to about 3,600 lamps the price for lighting the city for a year would be reduced from $276,655 to $216,505, making a saving of $60,505 a year. On a five-year contract this would amount to $302,525. The Rochester Railway & Light Company has purchased the plant and holdings of the Eastern Munroe Company, of this city.

BROOKLYN, N. Y.—Extensive additions and improvements are being made to the Edison Electric Illuminating Company's system in this city, which, when completed, will cost more than $3,000,000. The greatest improvements will be made at the Gold Street station, which will have a capacity of more than 85,000 kw when completed. An Allis-Chalmers turbo-generator of 8,000 kw capacity is now being installed; within a short time a Westinghouse turbo-generator with a capacity of 11,000 kw will be put in commission, and a third turbo-generator of a larger size will be installed in 1907. During the coming year the foundation for a new boiler house will be laid, which will have a capacity of 52,000 hp. It is expected to install 16 of the 80 boilers at first. Many improvements and additions have been made to the Bay Ridge power house at a cost of $750,000. The capacity of the Bay Ridge station exceeds 14,000 kw.

LUMBERTON, N. C.—The Council is considering the question of issuing $15,000 water and light bonds.

FAYETTEVILLE, N. C.—A syndicate composed of prominent business men of this city has been granted a franchise for a street railway in the city. Work will begin on the road at once.

WEST ASHEVILLE, N. C.—The Buckeye Water Co. has recently perfected an organization with R. P. Hayes, president, and has secured the right to operate a power distributing plant and telephone exchange.

CHARLOTTE, N. C.—Surveys of routes have been about completed by the Southern Power Company for its transmission line to Concord. The electricity will be used in cotton mills and manufacturing establishments.

RALEIGH, N. C.—Judge Purnell, of the Federal Court, has decided to order an immediate sale of the Cape Fear Company's plant at Buckhorn, being constructed to supply electricity for manufacturing and other purposes at Fayetteville. The plant will be sold in an incomplete condition, and an order for the sale will be issued within 60 days.

SHELBY, N. C.—The Shelby Electric Light Company has contracted with the Lily Mill & Power Company to furnish it with electricity to be delivered at the sub-station of the Shelby Electric Light Company in the town. The machinery has already been purchased and the change will be made within 60 days. A day service will be established as soon as the the new system is completed. Other improvements are contemplated. A. W. McMurray is secretary and treasurer.

MARION, OHIO.—The power plant of the Marion Railway, Light & Power Company was wrecked by an explosion on Aug. 22.

FOSTORIA, OHIO.—Work will commence at once on the construction of the plant of the City Heat & Lighting Company in this city. J. J. Cramer is manager.

HUDSON, OHIO.—Bids will be received until Sept. 4 by the Board of Public Service, Cleveland, for installing an electric lighting plant for the City Farm School, near Hudson. A. R. Callow is secretary.

COLUMBUS, OHIO.—The Lazarus electric light plant on West Town Street was badly damaged on Aug. 17 by flooding of the machinery. A new generator recently installed to operate the pump was nearly ruined.

CINCINNATI, OHIO.—John W. Hill & Sons have prepared plans for the erection of a power plant for the Little Miami Light, Heat & Power Company on Little Miami River, at Milford. The probable cost is $20,000.

CINCINNATI, OHIO.—The Cincinnati, Georgetown & Portsmouth Railroad is making important improvements to its line. The contract has been let for the extension of the line to West Union, and the new Felicity branch has been completed as far as Mt. Olive.

EAST LIVERPOOL, OHIO.—The East Liverpool Traction & Light Company will erect a new power station on Island Run, a branch of Beaver Creek, this being decided upon because the plant would adjoin extensive coal properties which the company secured some time ago. Van Horn Ely is president.

ALLIANCE, OHIO.—Plans for building the Cleveland, Ravenna & Alliance Railway are progressing smoothly. The road is being promoted by J. W. Holcomb and C. R. Morely, of Cleveland. Practically all of the right of way has been secured, including an entrance into the outskirts of Cleveland. B. N. French, of Salem, chief engineer for the project, is making surveys for the road.

NELSONVILLE, OHIO.—The promoters of the Nelsonville, Athens & Glouster Traction Company are preparing to place their project before financiers in the East. The length of this line will be about 40 miles, connecting Nelsonville, Athens and Glouster. It is stated that 75 per cent. of the right of way has been secured and the remainder can be obtained as soon as the financing arrangements have been completed.

CINCINNATI, OHIO.—The Union Gas & Electric Company has leased the plant of the Cincinnati Gas & Electric Company for a term of 99 years. The company agrees to spend $2,000,000 within five years for improving the service and erecting additional power houses and other plants. The company has a capital stock of $20,000,000. A. S. White, C. A. Leib and J. J. Rollins, of New York, and R. W. White, of Cleveland, are directors of the new company; Norman G. Kenan, of Cincinnati, will be president of the company.

CLEVELAND, OHIO.—The Sandusky, Fremont & Southern Railway Company has increased its capital stock from $100,000 to $2,000,000. Of the bonds, $500,000 have been sold and the proceeds will be used to construct 17 miles of track between Sandusky and Fremont. Another million will be sold next spring to build the line from Fremont to Fostoria and Tiffin. The Fremont power station will be enlarged to take care of the extensions. F. J. Stout is manager.

MARION, OHIO.—The Marion County Commissioners have granted a franchise to the Findlay, Forest & Marion Railway Company for building its line along the Garden City pike from the corporation line to the Kenton and Marion pike. The company has secured practically all its right of way and expects to commence work of grading early in the spring. H. Hankey, secretary of the company, claims that arrangements for financing the project are progressing satisfactorily.

GUTHRIE, OKLA.—Complete surveys have been made for the Washita Valley Interurban Railway from Denison, Tex., to Davis, I. T., and are now being extended to Chickasha. W. T. Croslen, general manager, states that construction will commence this fall.

GUTHRIE, OKLA.—A franchise has been granted by the City Council, of Edmund, to the Newkirk, Tonkawa & Southern Interurban Company, which proposes to build an electric railway connecting the principal towns in Kay, Noble, Logan and Oklahoma counties.

SALEM, ORE.—Surveys have been made for a proposed electric railway from Salem to Mehama, which is projected by A. Welch. Right of way will soon be secured for the road.

GOLD HILL, ORE.—The Gold Hill Canal Company is constructing a new power plant with a capacity of 10,000 hp, to be installed in units of 1,700 hp. each. Only two of the units will be installed this year. Daniel Lesley is manager.

KLAMATH FALLS, ORE.—Surveys are soon to be made for the projected electric railway to connect Klamath Falls with Bonanza, Merrill and other points within the Klamath Basin. Gen. C. M. Idleman, of Portland, is one of the incorporators.

MILTON, ORE.—The Milton City Council met Aug. 7 for the purpose of taking preliminary steps toward granting the Walla Walla Traction Company a twenty-five years' franchise for an electric railway into the city. It is understood that the company has made all arrangements to go on with the work of construction.

BAKER CITY, ORE.—The Eagle River Electric Company has completed plans for the construction of a power plant on the Eagle River. Work has commenced on the erection of the transmission line from a point near Sauger to Baker City, a distance of 28 miles. The plant will have a capacity of 2,000 hp. F. W. Paine is president and Frank A. Moore, treasurer.

PITTSBURG, PA.—At a special meeting of the stockholders of the Philadelphia Company, Aug. 15, it was decided to increase the common stock of the company from $36,000,000 to $42,000,000.

POTTSTOWN, PA.—The Pottstown Light, Heat & Power Company will soon extend its electric lighting service to Stowe and Bramcote. Later other extensions will be made to Douglassville, South Pottstown and Sanatoga.

PHOENIXVILLE, PA.—The Phoenix Gas & Electric Company will install a cross compound Buckeye engine of 750 hp and 500-kw General Electric generator in its plant before January 1, 1907. E. N. Corbin is superintendent.

GREENVILLE, PA.—A receiver has been appointed by Judge Williams to take charge of the Peoples Electric Light, Heat & Power Company, which is said to be heavily involved. The plant represents an outlay of $150,000 and the company holds the city lighting contract.

EBENSBURG, PA.—The Conemaugh Valley Railroad Company will begin the construction of a railway which will be operated by electricity between Johnstown, in Cambria County, and Ebensburg, a distance of about 20 miles, with a power plant in the vicinity of South Fork. The officers of the company are as follows: P. J. Little, president; Ebensburg, Pa.; James P. Thomas, vice-president, Johnstown, Pa.; A. H. Walters, secretary. Johnstown, Pa.; William C. Krueger, treasurer.

ASHLEY, PA.—Work will soon commence on the installation of an electric light plant at the shops of the Central Railroad of New Jersey, for the purpose of lighting the shops and yards. Four dynamos have been received, two of which will furnish electricity for 1,400 incandescent lamps and the other two will supply electricity for 50 arc lamps about the yards. Extensive changes will be made in the boiler and engine house; new Babcock-Wilcox boilers and larger engines will be installed

MEADVILLE, PA.—Work has been started on the Meadville, Conneaut Lake & Linesville Street Railway beyond Fredericksburg. The distance from Meadville to Linesville is 15 miles, and from Meadville to Exposition Park by this line is 9 1-10 miles. The company was granted a permit by the City Council to enter the city over the Meadville Traction Company lines, at a special meeting held two weeks ago, and are beginning the work. The company is capitalized at $1,250,000 and this will cover additions to the main line. Frank R. Shyrock, of Meadville, is president.

PITTSBURG, PA.—President E. R. Walters, of Select Council; President William Brand, of Common; Select Councilman H. B. Burns and several others have under consideration the matter of building an electric railway into Schenectady and Highland Parks, and at the beginning of regular sessions of the Councils next month it is the intention to authorize a joint committee to investigate the feasibility and cost of the project, and if the results of the investigation are satisfactory to submit to the vote of the people a bond issue for the construction and equipment of the road.

UNION, S. C.—A committee has been appointed with Alderman G. C. Perrin, as chairman, to procure estimates for remodeling the electric light plant, the bids to be opened Sept. 4.

CHARLESTON, S. C.—The Simons-Mayrant Company, 16 Broad Street, Charleston, has secured the contract for the construction of a central power plant, known as Building No. 23, at the Charleston Navy Yard, for about $140,000.

HOWARD, S. D.—W. H. Blair and Edward Guthier have secured a franchise for an electric light plant.

UNION CITY, TENN.—A Corliss engine of 90-hp is now being installed in the municipal electric light and water works plant. A. Wade is manager.

MEMPHIS, TENN.—A preliminary survey for an electric railway from Covington, Tenn., to Memphis, a distance of about 30 miles, are being made. Business men at Covington and along the route have subscribed to pay the survey, and they propose to build the road.

MEMPHIS, TENN.—The proposed interurban line of the Lakeview Traction Company, from Memphis to Clarksdale, Miss., has been surveyed for its entire distance. H. E. Craft, president of the company, states that work on the northern portion of the line will commence soon.

JACKSON, TENN.—Contracts have been let by the Jackson Railway & Light Company for the construction of the new power station, office, car barn, shop, etc., at a cost of $25,000. The contract for the power house equipment has been let to Joseph Williams & Company, of Louisville, Ky., and includes two 300-kw Parson turbo-generators and equipment of rotary exciters, switchboard, etc., and three 230-hp Vogt water tube boilers; also condenser pumps, etc. S. S. Bush, of Louisville, Ky., is vice-president and general manager.

BROWNSVILLE, TEX.—The City Council has granted the Brownsville Water, Light & Power Company a franchise for water works and an electric light plant.

TERRELL, TEX.—Thos. B. Bond, Mayor, writes that it is proposed to construct an electric light plant, at a cost of $15,000. J. D. Smith, of Terrell, is engineer.

DENTON, TEX.—A franchise has been granted by the City Council to Newton M. Lee and associates to construct and operate a street railway system in this city.

VIRGINIA, TEX.—B. F. Berties and F. B. Meyers, representing the Northern Traction Company and the Mesaba Traction Company, have made an application to the City Council for a street railway franchise for their companies in this city.

BENNINGTON, VT.—The New England Telephone & Telegraph Company has commenced the construction of 4,000 feet of underground conduit in the principle parts of the city.

CAVENDISH, VT.—It is reported that a large power plant is to be built here by Boston capitalists to supply electricity for Claremont, N. H., industries. A transmission line of 16 miles in length will be built.

NORFOLK, VA.—It is reported that the Norfolk & Western Railroad will build an electric lighting plant at the foot of coal pier No. 7 at Lambert's Point, near Norfolk, Va., to cost $50,000, to furnish electricity for lighting Norfolk, Berkeley and Portsmouth, Va.

WARRENTOWN, VA.—The Warrentown Electric Company will soon install new boilers in its plant. The company also contemplates the construction of a hydro-electric plant to operate its system in Warrentown and several other plants. Bernard Thyson is manager.

MANASSAS, VA.—Official notice states that bids will be opened Sept. 19 by the Construction Committee at the People's National Bank of Manassas (O. E. Newman, chairman) for constructing water works and an electric light plant, etc. Specifications may be had on a deposit of $3.

LYNCHBURG, VA.—H. L. Shaner, city engineer, writes that plans and specifications are now being prepared by Lamar Lyndon, of New York, N. Y., for the proposed municipal electric light plant, to cost about $50,000. Date of receiving of bids for construction has not yet been decided upon.

BLAINE, WASH.—A new boiler and engine will soon be installed in the plant of the Blaine General Electric Company. Theodore Beeson is manager.

BUCKLEY, WASH.—A new engine and dynamo will be installed in the plant of the Buckley Electric Company this fall. W. A. Shumaker is manager.

SPOKANE, WASH.—The Hydra Electric Development Company has decided to develop the water power of Spokane, and construct a dam and power plant.

TACOMA, WASH.—The Syndicate Heat & Power Company contemplates increasing the dynamo capacity of its plant during the next year. Calvin Philips is manager.

BELLINGHAM, WASH.—The Whatcom County Railway & Light Company has been granted franchise rights by the City Council to operate a street railway on several streets in the city.

SEATTLE, WASH.—It is stated that an electric railway is to be built from Ketchikan, Alaska, to Unik River, next year, by the Unik River Mining & Smelting Company. J. W. Daly is manager of the company.

VANCOUVER BARRACKS, WASH.—Bids will be received by the Constructing Quartermaster, U. S. A., until Sept. 24, for furnishing electric light fixtures for two double barracks and three double sets of officers' quarters, including service connections.

SEATTLE, WASH.—The city has accepted the bid of the Seattle Electric Company and passed the franchise for the Spokane Avenue Street Railway line through the limits of West Seattle, from which point the line will be extended through West Seattle and on to Alki Point.

BEAVER DAM, WIS.—The Wisconsin Telephone Company contemplates remodeling its system in this city at a cost of $30,000.

RACINE, WIS.—The Wisconsin Telephone Company is making arrangements and having surveys made for the construction of its underground system between this city and Kenosha.

NEW WESTMINSTER, B. C.—The British Columbia Electric Railway Company has decided to build the extension from New Westminster to Chilliwack.

VANCOUVER, B. C.—The plans of the Stave Lake Power Company, now building a dam on the Stave River for the conservation of the water of that stream for use in the generation of electrical energy, have been amplified so that instead of having a maximum of 20,000 hp there will be available 40,000 during the driest season.

NELSON, B. C.—The city is constructing a hydro-electric plant at Bonnington Falls to operate the municipal lighting system. The hydraulic work is finished and the machinery will be installed this month. Plans have been made for developing 5,000 hp; the first unit installed will be of 1,250 hp. A transmission line 10 miles in length having a potential of 12,000 volts is being erected. W. R. Dickson is superintendent.

EMERSON, MAN.—The Roseau-Howard Power Company is preparing plans to develop 16,000 hp on the Rosseau River here at a cost of $600,000. The power plant will cost $200,000.

MEXICO CITY, MEX.—The contract for supplying the generating equipment for the electrical installation of Molino La Union, of Toluca, has been awarded to G. & O. Braniff & Co., representatives of the Westinghouse Electric & Manufacturing Company.

LONDON, ONT.—A. E. Welch, of this city, is to finance and build the North Midland Electric Railway. The road will extend from London to Stratford, a distance of 35 miles.

DELHI, ONT.—Bids are wanted until Sept. 3 for turbine water wheels, governor, etc.; generators, exciters, switch panel, etc., for the Delhi Light & Power Company. Plans and specifications are at the office of John S. Fielding, consulting engineer, 15 Toronto Street, Toronto, Ont., to whom bids may be sent, or to the office of the company at Delhi.

QUEBEC, QUE.—The Quebec Railway, Light & Power Company is building a large hydro-electric plant about half a mile above its present power plant at Montmorency Falls. A dam 84 feet high is being constructed. The plant will consist of a 1,500-kw alternating-current generator and a 2,225-hp water wheel. It is expected to be in operation by Dec. 1, 1906. To provide for further demands, the company has under consideration a further development at the Three Falls, two miles up the river.

Company Elections.

BIRMINGHAM, ALA.—At the annual meeting of the Coosa River Electric Power Company, held recently, the following named officers were elected: Roswell H. Cobb, of Anniston, president and manager; Robert R. Zell, of Birmingham, vice-president; Gen. Robert D. Johnston, of Birmingham, treasurer; Cyrus K. Hartzell, of Pittsburg, secretary.

AMHERST, MASS.—The Massachusetts Public Service Company, organized to distribute electricity from the new plant at Turners Falls, has elected the following-named officers: James F. Barry, president; E. D. Marsh, vice-president; David Barry, secretary and treasurer. The directors are the officers and C. Fred Deuel and M. A. Dickinson. The company is capitalized at $300,000.

New Industrial Companies.

THE LEFFLER ELECTRIC COMPANY, of Alton, Ill., has been organized in Chicago under the Maine laws, with a capital stock of $5,000,000. A. E. Bassett has been elected president.

THE BORBEIN AUTO COMPANY, of St. Louis, Mo., has been incorporated with a capital stock of $10,000. The object of the corporation is to manufacture and sell steam, gasoline and electric automobiles. The incorporators are: H. F. Borbein and W. L. Johnson, Charles Borbein and Sadie V. Johnson.

THE SMOKELESS FURNACE COMPANY, of New York City, has been incorporated, with a capital stock of $1,000,000, to manufacture apparatus for the smokeless combustion of soft coal and the more economical combustion of anthracite coal. The directors are Theodore F. Dobecki, Henry R. Sadler, Walter B. Tuthill, Ralph Mendelson, Arthur Boyce, of New York City.

THE HAYS ELECTRIC MANUFACTURING COMPANY, of Indianapolis, Ind., has filed articles of incorporation with the Secretary of State, with a capital stock of $10,000. The company has been formed to manufacture an automatic electric sign invented by Bush Hays. The factory will be established in this city. Dr. Franklin Hays, John B. Cockrum, Bush Hays and Oakley Cockrum are the directors.

New Incorporations.

LITTLE ROCK, ARK.—A charter has been granted by the Secretary of State to the Telephone Company of Little Rock, with a capital stock of $300,000. W. D. Hearn, of Pine Bluff, is president; P. C. Ewing, of Little Rock, vice-president; Charles F. Speed, of Texarkana, secretary. The officers and Mack Hammett and W. M. Rickert are directors.

ATLANTA, GA.—The Atlanta, Griffin & Macon Electric Railway has been granted a charter by the Secretary of State, with a capital stock of $100,000. The incorporators are N. P. Pratt, W. A. Wimbish and E. P. Ansley, of Atlanta, Minter Wimberly, of Macon, and others.

ROODHOUSE, ILL.—The Central Light, Heat & Power Company, of Roodhouse, has been incorporated by F. H. Anderson, H. J. Mogner and others.

WESTERVELT, ILL.—Articles of incorporation have been filed for the Ridge Telephone Company, with a capital stock of $3,000 by A. P. Weakley and others.

PORTLAND, ME.—The Portland & Northern Railroad has applied to the Secretary of State for a charter to construct a road from Cumberland Mills to Westbrook, and thence to Bridgton, covering a route of about 38 miles. The directors are Sumner O. Hancock, of Casco; Edward M. Mason, of Raymond; Ephraim B. Jillson, of Otisfield, and others. John L. Meserve is acting as secretary and treasurer until the incorporation is perfected.

KENTON, MO.—The Cimarron Telephone Company has been incorporated with a capital stock of $1,000 by Edwin Bookhart and others.

KANSAS CITY, MO.—Articles of incorporation have been filed for the Viaduct Light & Power Company, with a capital stock of $10,000. The incorporators are Kimbrough Stone and others.

CLAYTON, MO.—The Creve Coeur Mutual Telephone Company has filed articles of incorporation with a capital stock of $1,000. The directors are: Andrew Seeger, R. Grasser and Doctor John D. Pfister.

HUNTSVILLE, MO.—The Huntsville Light & Power Company has been incorporated with a capital stock of $75,000. The incorporators are Charles E. Vallette, Cameron F. Roberts, George S. Marshall, John A. Campbell and Arthur F. Day.

ATKINS, MO.—Articles of incorporation have been filed for the Atkins Telephone Company, with a capital stock of $10,000, by G. T. Brown, J. F. Burris, H. C. Bledsoe, W. A. Wilson and J. R. Reynolds. The company recently purchased the plant of the Russellville Telephone Company.

OMAHA, NEB.—The Barker Block Light & Power Company has been incorporated, with a capital stock of $6,500. The incorporators are: N. J. Baker, H. G. Unversagt and W. S. Weaver.

JULIAN, NEB.—Articles of incorporation have been filed for the Farmers & Merchants' Mutual Telephone Company, with a capital stock of $5,000, by George F. Conlon, James Lockwood and others.

HACKETTSTOWN, N. J.—The new Hackettstown Telephone & Telegraph Company has been organized and officers elected as follows: William A. Hoffman, president; Peter H. Welch, vice-president; Robert A. Cole, treasurer, and Charles W. H. Dedrick, secretary.

TRENTON, N. J.—A certificate of incorporation has been filed with the Secretary of State by the reorganized Interstate Telephone Company. The newly incorporated company was formed by the reorganization committee for the purpose of taking over the business from the committee. The property was purchased by the committee at the receivership sale Aug. 22, for $575,000. The new company has a capital stock of $500,000. The agent in charge is Henry B. Swartz.

BREESPORT, N. Y.—Articles of incorporation have been filed for the Breesport Telephone Company, with a capital stock of $2,100, by C. H. McKinley and others.

BUFFALO, N. Y.—The Frontier Electric Railway Company, with a a capital stock of $300,000, has been organized to construct an electric road between Niagara Falls and Buffalo.

COOPERSTOWN, N. Y.—The Cooperstown & Northern Railway Company has filed articles of incorporation with the Secretary of State, with a capital stock of $240,000. The new railroad is to operate in Otsego County, between Cooperstown, Springfield and East Springfield. The directors are Sheldon A. Young, of East Springfield; Fred J. Maxted and Charles A. Stannard, of Springfield.

FAYETTE, N. C.—A charter has been granted the Fayetteville Street Railway & Power Company, with a capital stock of $100,000, for the purpose of operating electric lines in the town and within a radius of 50 miles of Fayetteville, and also to supply light and power. W. D. McNeill, J. F. Harrison and others are the incorporators.

CONCORD, N. C.—A charter has been granted to the Concord Realty & Railway Company to build a 21-mile electric road from Charlotte to Concord, with a capital of $125,000. The following are the incorporators: R. A. Brown, L. A. Brown and J. L. Brown, of Concord, and C. W. Johnston, of Charlotte, and E. A. Johnston, of Rock Hill, S. C.

NAVARRE, OHIO.—The Navarre Electric Light Company, of Navarre, has been incorporated, with $10,000 capital stock by John W. Zinsmaster, George A. Myer, David A. Fisher, Peter Zinsmaster and Charles Fetters.

MIDDLEPORT, OHIO.—The Mutual Electric Light Company, of Middleport, has been incorporated with a capital of $50,000 by James Murtha, W. E. Russell and others.

COX'S LANDING, OHIO.—Articles of incorporation have been filed for the Cox's Landing Telephone Company with a capital stock of $3,000 by W. H. Lyons, W. C. Summers, F. A. McDonald, A. M. Sykes and A. F. Saunders, of Huntington.

CINCINNATI, OHIO.—The Cincinnati, Columbus & Toledo Railway Company, of Cincinnati, has been chartered with an initial capital stock of $10,000 by Richard C. Swing, H. G. Gibson, Harry E. Frost, H. H. Hoffman and C. B. Matthews. The company proposes to construct a steam or electric road connecting Cincinnati and Toledo.

CINCINNATI, OHIO.—The Cincinnati, Reading & Middletown Traction Company has been formed by Guy N. Mallon, W. S. Burkehardt and others of Cincinnati. The company has a preliminary capital stock of $10,000, which will be increased later to $1,000,000. It is proposed to build an electric railway from Avondale to Middletown, a distance of 28 miles.

Legal.

TROLLEY SWITCHES AND FROGS.—An opinion has been filed by Judge Cross of the United States Court of the District of New Jersey in a case involving the use of overhead switches and frogs on electric railways. This method of overhead construction was patented by Van Deposle, Patent No. 424,695, dated April 1, 1890, and assigned to The Thomson-Houston Electric Co. The suit was brought against the Sunday Creek Company, which owns or controls 29 electrically equipped mines in Ohio and West Virginia. In these mines, there were in use a large number of electric locomotives manufactured by the Jeffrey Manufacturing Co., the Morgan-Gardner Electric Co., and the Goodman Manufacturing Co. The only licensees under the Van Deposle patent, however, are the General Electric Co. and the Westinghouse Electric & Mfg. Co., and as a result of this decision of the United States Court the Sunday Creek Company has been enjoined from the further use of any infringing switches and frogs, and has been allowed sixty days from the filing of the opinion to make arrangements for the discontinuance of the use of the infringing switches, frogs and locomotives.

Obituary.

MR. LEVI W. EATON.—The death occurred last week at Bridgeport, Conn., of Mr. L. W. Eaton, president of the Bryant Electric Company. Mr. Eaton was born in Springfield, Mass., seventy-five years ago, and his boyhood days were passed in that city. He removed to Windsor, Vt., at an early age where he learned the machinist's trade, and later on he went to Colt's Armory at Hartford. Leaving there he went to the Wheeler & Wilson Manufacturing Company in the early days of that company, and was with them as a contractor for 39 years. In 1891 Mr. Eaton became president of the Bryant Electric Company, and retained that office until his death. In his private life Mr. Eaton was quiet, unassuming and much given to charitable deeds. He was of strong religious tendencies, having been a member of the South Congregational Church since 1860. He was a member of the Seaside club of Bridgeport, and was a trustee of the old Bridgeport Savings Society. He was also a Trustee in the Bridgeport Savings Bank.

Personal.

MR. J. R. KEARNEY.

MR. JAMES R. KEARNEY, superintendent of construction of the Topeka, Kan., Edison Co., began his electrical career at the age of 15, as wiper in the engine room of the old Brush Co., of Topeka in 1891. He held succesively the positions of wiper, helper in the boiler room, and fireman, all the time devoting his spare moments to the study of electricity. From the position of fireman he was promoted to dynamo tender and then to tuning arc lamps, which in those days of complicated and varied makes required a man thoroughly versed in a knowledge of electricity. From this position it was only a short step to foreman of the arc lamp department. Shortly after this he was given charge of all the machines and the title of assistant superintendent. In 1895, Mr. Kearney resigned from the Brush Co. to accept the position of general superintendent of construction for the Overton Construction Co. He installed a plant for the Sante Fe Railroad, at Newton, Kan., and another at the Topeka State Insane Asylum. After two years he left the Overton Company to accept his present position in the construction department of the Topeka Edison Company. One of the things that attracted his attention and caused him no small amount of worry and experimenting was the enormous amount of time, labor and material that was necessary in turning a corner with heavy power cables. He never liked the idea of cutting cable to make a splice at these corners because he knew that a spliced joint is never as strong or as serviceable as the solid wire, and in addition it caused a great waste of cable and decreased the scrap value when it was taken down. He inquired from managers all over the country for a way to overcome this waste. He found that the general practice was to use the soldered joint, and that where he wasted from ten to twelve feet in making the splice and turn, others wasted many more feet of cable. In addition to this waste was to be added solder, line loss at splices, tape, broken saw blades and labor. After careful experimenting Mr. Kearney perfected and patented a clamping device that eliminated all of this waste. It was not expensive, it was easy to install and could be adapted to all conditions. He has used over a thousand of them on the work of the Topeka Edison Company alone, saving that company in the neighborhood of $5,000. He made arrangements with W. N. Matthews & Bro., of St. Louis, to manufacture and sell the Kearney cable clamp, and the sale has extended all over the United States, Canada and Mexico. Mr. Kearney is at work on other devices and is the type of man from whom many needed improvements in the field of heavy current utilization are to be expected.

MR. A. S. MERRILL, formerly of New York, is now in charge of the Chicago office of Pass & Seymour, Inc., as sales agent.

MR. GEORGE WESTINGHOUSE has returned to this country after a longer stay abroad than was intended when he left in the early summer.

MR. W. D. ALEXANDER, of Charlotte, N. C., has been elected to succeed J. G. Ryan as superintendent of the water and electric lighting systems at High Point, N. C.

MR. JOHN B. ROGERS, of San Francisco, Cal., has been elected vice-president and director of the United Railways, of Portland, Ore., to succeed W. D. Larrabee, resigned.

MR. H. H. SCOTT, general superintendent of the Madison, Wis., Gas & Electric Company, has resigned recently to become traveling consulting engineer for the American Light & Traction Company, for the duties of which position he is admirably qualified.

MR. F. M. RICHARDS, superintendent of motive power for the Madison, Wis., Gas & Electric Company, has been promoted to general superintendent of the company. He is a competent engineer and has worked his way up in the technical end of the business.

MR. JAMES ROSS has retired from the presidency and directorate of the Mexican Light & Power Company. His successor is Sir Geo. A. Drummond, president of the Bank of Montreal. Charles H. Cahan, the company's solicitor, has been added to the directorate.

MR. L. D. RICHARDSON, who for three years past has been general manager of the Twin City Telephone Company, and for two years general superintendent of the Tri-State Company, has resigned to become general manager of the North Dakota Independent Company, with headquarters in Fargo.

MR. J. LESTER WOODBRIDGE, formerly engineer of the sales department of the Electric Storage Battery Co., Philadelphia, has been appointed chief engineer of that company, succeeding Mr. J. B. Entz, who has resigned to accept the position of vice-president of the Electric Vehicle Co., of Hartford, Conn.

MRS. FRANCES A. W. McINTOSH, formerly advertising manager of the Standard Tool Company, Cleveland, O., and more recently connected with the advertising department of *Power*, New York, now has charge of the publicity department of the Norton Company, Worcester, Mass., the appointment taking effect Aug. 1.

MR. L. P. SAWYER, manager of the Buckeye Electric Company, called the representatives of that company together in Cleveland last week for their annual meeting and conference. Three days were devoted to the conclave, which was attended not only by all the Buckeye salesmen and district managers but by representatives from a number of supply houses that handle Buckeye incandescent lamps.

MR. W. D. McFARLAND, vice-president of the Westinghouse Electric & Manufacturing Company, has issued a memorial brochure as a tribute of affection to the late Capt. John C. Kafer, U. S. N., past president of the Engineers' Club, whose pupil and friend he was. The biographical sketch is written with admirable taste and delicacy, and will be appreciated by every one who knew the gallant and distinguished engineer it portrays.

MR. C. L. KINSLOE.—Mr. Charles Lambert Kinsloe, of Lock Haven, has been elected assistant in the electrical engineering department of Western University. He was graduated from the engineering department of State College, Pennsylvania, in 1903, with the degree of bachelor of science, and for some time afterward was employed at the Westinghouse works in Wilmerding. Latterly he has been engaged in experimental laboratory work in the engineering department of the Philadelphia Electric Company.

MR. GEO. B. TRIPP has resigned his position as general manager of the Gas and Electric Companies of Colorado Springs, Col., and on Sept. 1 will join the organization of Messrs. Curtis & Hine of that city, engineers and central station managers. Messrs. Curtis & Hine have under way several large power projects, which, in connection with their general central station work, will provide wide scope for the ability and energy which Mr. Tripp has evidenced in the past five years in managing the Colorado Springs plant.

MR. P. E. RISHEL has been appointed Pennsylvania representative of the Metropolitan Engineering Company, of Brooklyn, N. Y., and will make his headquarters at Punxsutawney, whence he will be able to handle advantageously the trade in the western part of the State and adjacent territory. Mr. Rishel is well known in the industry, and is a warm advocate of smaller station development, believing that in the aggregate the market there for signs, fans, etc., is as large as in the populous cities. Mr. Rishel has already assumed his new duties.

MR. T. E. MURRAY, vice-president of the New York Edison Company, has been spending part of the summer at the Catholic Summer School, near Plattsburg, N. Y., on Lake Champlain. He is well known as a fine vocalist, having an unusually pure tenor, and the local newspapers are enthusiastic over his numbers in concerts given there. One says: "Mr. Murray's tenor is one of the best ever heard at Cliff Haven. It is pure and firm, and so flexible that the mere tone is a delight." Mr. Murray excels in Irish songs given with a clever dash of the brogue.

MR. MAX LOEWENTHAL, consulting electrical heating engineer, having been commissioned by John Wanamaker to reorganize the electrical supply department, is now installing a very elaborate display covering a floor area of 1,600 square feet in the basement of the new New York building. A model kitchen and bedroom are being erected, in which every conceivable electro-domestic appliance, from a push button to a refrigerating plant, will be shown in operation. Electric cooking will be demonstrated at another portion of the exhibit, which will be open to the public during the first week in September.

MR. WALTER C. KERR is, *facile princeps*, the leading exponent in America on the oratorical platform, of the ideas, principles and motives that should actuate engineers as professional men; and as a speaker to the rising and graduating youth of the country he has delivered these many years past a most inspiriting series of addresses at college and school commencements. One of his latest, just put into pamphlet form, on "Knowledge and Action," was delivered to the class of 1906 at the Staten Island Academy, and is a splendid exposition of the thought that whether engineers, or in other walks of life, it is "the least duty of everyone to make the world just a little better."

Educational.

CORRESPONDENCE SCHOOL ANNIVERSARY.—It is interesting to note that the students of the International Correspondence Schools will celebrate the fifteenth anniversary of the schools, at Scranton, Pa., on October 16. It has been nearly 15 years since Thomas J. Foster, then editor of a newspaper in Shenandoah, Pa., introduced a method of teaching through the mails by means of special home-study textbooks and a system of direction and correction of students' work, the object of which was to enable the coal miners of Pennsylvania to pass the required examination for mine foreman. Although the enterprise was of great interest in the mining communities, not even the founder then dreamed that his plan was the creation of a new educational system that was to turn the world into a vast class room. The International Correspondence Schools now have more than two hundred courses of instruction, covering almost every branch of nearly all of the well-known trades and professions. Up to the present time, 85,000 students have either completed the courses for which they enrolled or substantial portions thereof; 225,000 other students have completed the study of mathematical, physical and drawing subjects. One hundred and fifty-three railroads, including some of the largest systems in the world, have made contracts with the schools for the instruction of their engineers, firemen, machinists, inspectors and other employes. The day will be taken up with appropriate exercises and an interesting exhibit of the schools at work preparing and printing homestudy textbooks and correcting the recitations of students sent in from every part of the civilized world. A banquet to the guests will be given by the schools in the evening.

Trade Publications.

OUTLET BOXES.—Bulletin No. 609 of the Stanley-G. I. Electric Mfg. Company, Pittsfield, Mass., is devoted to water-tight floor outlet boxes, and seamless wall outlet boxes.

ENCLOSED ARC LAMPS.—Bulletin No. 4,452 of the General Electric Company, Schenectady, N. Y., gives a complete price list of parts of direct-current series enclosed arc lamps.

SYNCHRONIZING SWITCHES.—A compact form of synchronizing plug switch is described and illustrated in bulletin No. 4449 of the General Electric Company, Schenectady, N. Y.

ENCLOSED ARC LAMPS.—A price list of parts of plain type carbon-feed enclosed arc lamps is contained in supply catalogue No. 7598 issued by the General Electric Company, Schenectady, N. Y.

STEAM METERS.—The Sargent Steam Meter Company, First National Bank Building, Chicago, Ill., has issued a folder describing a steam meter for showing at a glance the quantity of steam being used.

TESTS OF INSULATORS.—Engineering sheet No. 6, of the Locke Insulator Manufacturing Company, Victor, N. Y., gives a complete outline of the tests to which high-voltage insulators should be subjected.

LOCOMOTIVE CRANES.—A profusely illustrated catalogue recently received from the Wellman-Seaver-Morgan Company, Cleveland, Ohio, is devoted to locomotive cranes, excavating buckets and dumping tubs.

RAILWAY CONTROL APPARATUS.—Supply catalogue No. 7596 of the General Electric Company, Schenectady, N. Y., is a 51-page publication dealing with Type M control apparatus for railway motors.

BOILERS.—The E. Keller Company, Williamsport, Pa., in its general catalogue gives much valuable information concerning boilers of the tubular, portable and marine types, fire grates, water tanks and self-supporting steel stacks.

INSULATING MATERIAL.—The D. M. Steward Manufacturing Company has issued a bulletin containing mechanical drawings with descriptive matter and report of tests of "Lavite," an insulating material which it manufactures.

LUMINOUS ARC LAMPS.—Supply catalogue No. 7599 of the General Electric Company, Schenectady, N. Y., is devoted to luminous constant-amperage, direct-current series enclosed arc lamp with swinging upper electrode.

ROCK CRUSHERS.—In its bulletin No. 1411 on modern rock crushing plants, the Allis-Chalmers Company presents a large amount of data relative to their design and operation, together with the illustrated descriptions of the machinery required.

COMBINATION INSTRUMENT.—The H. W. Johns Manville Company, of New York, N. Y., has published a leaflet describing the Victor combination meter, a direct reading instrument giving volts, amperes, watts and horse-power simultaneously.

TELEPHONES.—The Electric Goods Manufacturing Company, 115 Purchase Street, Boston, Mass., has issued as its general descriptive catalogue a well-illustrated 64-page publication giving a few examples of representative installations of telephone and annunciator boards.

LIGHTNING ARRESTERS.—Catalogue No. 1052 of the General Electric Company, Schenectady, N. Y., gives an outline of the features required for the protection from lightning, and describes in great detail lightning arresters of the shunt resistance multigap type.

HOISTING MACHINERY.—Catalogue G of the Mead-Morrison Mfg. Company, Cambridge, Mass., is a well illustrated publication dealing with hoisting machinery for contractors. These hoists are of the steam-driven type. Electric hoists are discussed at some length in catalogue E of the same company.

TELEPHONE BATTERIES.—The Gould Storage Battery Company, 1 West 34th St., New York, has issued an attractive booklet calling attention to the advantages of storage batteries over primary cells for use with telephones, and pointing out the excellent features of the Gould battery for this service.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is sending out to the trade its August price list applying to its general catalogue No. 24. The prices quoted are the very latest in force and it is suggested that any one that has been overlooked in the distribution write the Central Electric Company for a copy.

AIR BRAKE EQUIPMENTS.—Bulletin No. 363 of the National Electric Company, Milwaukee, Wis., gives a complete detailed description of stationary and portable motor-driven air compressors, while bulletin No. 364 of the same company shows the manner in which these compressors are applied to air brake equipments.

POYLPHASE INDUCTION MOTORS.—Bulletin No. 359 of the National Electric Company, Milwaukee, Wis., contains an interesting description of polyphase induction motors for all industrial purposes. These machines are built for ratings, varying from 1 hp to 75 hp, and are wound for voltages ranging from 110 to 2,200.

THREE-PHASE PANELS.—Three-phase panels suited to the prevailing voltages of 240, 480 and 600 and for controlling generators ranging in capacity from 22 to 400 kilowatts, with feeder panels for circuits of from 20 to 320 amperes, are described at length in bulletin No. 4447 of the General Electric Company, Schenectady, N. Y.

STORAGE BATTERIES.—Bulletin No. 7 of the Gould Storage Battery Company, Depew, N. Y., is devoted to a description of the central station plant at Odell, Ill., which maintains a 24-hour service in a town of 1,100 inhabitants by means of storage batteries for carrying the load from midnight until the heavy load comes on during the next evening.

LOCKE INSULATORS.—The Locke Insulator Mfg. Co., of Victor, N. Y., is issuing its new catalogue No. 9 prepared on the lines of catalogue No. 8. In addition to the regular English edition, there will be a "polyglot" edition in Spanish, French and German. This has become necessary on account of the demand for data and information arising from the large foreign trade built up by the Locke Company.

BELTED TYPE ALTERNATORS.—In an illustrated bulletin, designated as No. 1051, the Allis-Chalmers Company, Milwaukee, Wis., gives an outline of the features embodied in the construction of belt-driven alternators of the revolving field type. In the larger machines the stator is arranged for shifting sideways along the base to give access to the field and armature coils.

MANHATTAN ELECTRICAL SUPPLY COMPANY, from its handsome new headquarters, 17 Park Place, New York City, has sent out a list under recent date of discounts and net prices, together with changes and corrections applying to Catalogue No. 21. The circular letter directs attention also to important novelties such as the new and powerful dry battery known as "Red Seal."

METAL FOR VALVES AND COCKS.—A pamphlet isued by the Western Tube Company, Kewanee, Ill., describes a series of tests made upon various metals and alloys which tended to show that its so-called "high-duty" metal suffers less reduction in strength than any other known compound, and that it is specially suited for the manufacture of valves and cocks for extreme steam temperatures and pressures.

RAILWAY MOTORS.—Bulletin No. 4454 of the General Electric Company, Schenectady, N. Y., is devoted to the GE-90 direct-current railway motor which is rated at 50-hp, 500 volts. This motor is provided with extra large armature and axle bearings of the oil-and-waste lubricated type, extra large commutator and a three-point-suspension gear case. The motor complete with gear and case, weighs 2,875 lbs.

HIGH-EFFICIENCY LAMPS.—The General Electric Company, Schenectady, N. Y., has issued bulletin No. 4453, giving an instructive discussion of the Gem high-efficiency incandescent lighting units. Numerous diagrams are shown of the effective distribution of illumination over certain areas. Price list No. 5152 relates to the regular lighting units, while price list No. 5153 relates to Gem lamps for street service.

TRUMBULL ELECTRIC MFG. COMPANY, of Plainville, Conn., has issued a booklet dealing with some of the faults found in ordinary switches and thus incidentally advertising the merits of its Type C switch in which such defects are avoided or overcome. Copies of the publication will be gladly sent to anyone interested. The descriptive text is admirable, and in general style the pamphlet is quite dainty and artistic.

REFRIGERATING MACHINERY.—A 48-page pamphlet describing various types of horizontal and vertical ammonia compression refrigerating machines and equipment for ice plants, breweries, packing houses, etc., has just been issued by the De La Vergne Machine Company, foot of East 138th Street, New York, N. Y. The book is illustrated by many fine halftones, a feature of these being the clever and artistic arrangement of views of plants installed in various parts of the world.

ALTERNATING-CURRENT GENERATORS.—Bulletins dealing with alternating-current generators have been issued by the National Electric Company, Milwaukee, Wis., as follows: No. 358, giving a complete description of the construction of belt-driven machines; No. 360, devoted to water-wheel type generators, and No. 361, giving much information concerning direct-connected, engine-type alternators. All of these generators are constructed with revolving fields and stationary armatures.

BUSINESS GETTING METHODS.—The Co-operative Electrical Development Association, Cleveland, Ohio, has issued in pamphlet form, a reprint of the paper on "Organization and Conduct of a New Business Department Suitable for Central Stations in Cities of 50,000 Population and Under," by Mr. M. S. Seelman, Jr. This paper was the first prize winner among the papers on get-the-business methods submitted in response to the $1,000 in prizes offered by the National Electric Light Association.

DIRECT-CURRENT GENERATORS.—Bulletin No. 362 of the National Electric Company, Milwaukee, Wis., deals with direct-current engine type generators, of capacities varying from 25 kw to 1,000 kw. Bulletin No. 368 descibes belt-driven, direct-current generators rated at from 50 kw to 200 kw. Direct-current motors varying in size from 1 hp to 50 hp are discussed at length in bulletin No. 367, of the same company. These latter machines are provided with shunt-connected field windings and they can be used as generators when desired.

LARGE HYDRAULIC TURBINE.—A reprint of the article descriptive of a 10,000-hp single wheel turbine at Snoqualmie Falls, Wash., by Mr. Arthur Geisler, which appeared in a recent number of an engineering paper, together with comments on the hydraulic equipment, which appeared in the Electrical World on March 3, 1906, has been prepared for distribution in pamphlet form. The wheel described, which weighs 190,000 lbs., was built by the Platt Iron Works, according to the design of Mr. Geisler, its chief engineer.

SMALL ELECTRIC MOTORS.—Among the publications recently issued by the Emerson Electric Manufacturing Company, St. Louis, Mo., may be mentioned bulletin No. 3,110, describing single-phase induction motors with worm-gear, speed-reduction device; bulletin No. 3,203, dealing with direct-current motors for the same class of service; bulletin No. 3204, devoted to direct-current bipolar enclosed motors in sizes from .05 hp to .20 hp, and bulletin No. 3802, treating of air pumps driven by both direct-current and alternating-current motors.

SWITCHES, LAMPS AND FUSE BOXES.—The Stanley-G. I. Electric Manufacturing Company's Bulletin No. 611 is devoted to the G. I. snap switch, as one of the very few absolutely reliable snap switches on the market. Stanley-G. I. Circular No. 784 is devoted to the "G. I." incandescent lamps which are furnished for all circuits and conditions. The lamp, in common with the G. I. arc lamp, has a reputation for being ultra high-grade and of long life and high efficiency. Circular No. 781 describes the "G. I." type "J" primary fuse box or transformer cutout. Either circulars or bulletin may be had by addressing the home office at Pittsfield.

CENTRIFUGAL EXHAUST HEADS.—The B. F. Sturtevant Co., of Boston, Mass., has just issued Bulletin No. 138 in its Engineering Series descriptive of its centrifugal exhaust heads. Their action depends upon the fact that centrifugal force is proportional to the weights of the bodies in motion. As water weighs nearly 1600 times as much as exhaust steam, the effect of centrifugal force is to throw it outward with nearly 1600 times the force exerted on the steam. This process is applied in the Sturtevant head, within which the steam is given a vigorous whirling motion. As a result the entrained water and the oil is thrown against the outer casing and trickles down to the outlet at the bottom. The steam, now perfectly dry, finds ready escape through a central opening above. This exhaust head contains no baffle plates to rattle loose, produces no back pressure upon the engine, and insures perfect separation.

MOODY'S MANUAL.—Moody's Manual, issued by the Moody Corporation, 35 Nassau Street, New York City, has just made its appearance in a handsome volume of over 2,800 pages. It is more useful and valuable for reference than ever. The electric traction section embraces statements of practically all the street railway and traction companies in the United States and Canada. Full reports are given as to charters, franchises, capitalization, dividends, debts, income, plant and equipment, officers and directors, including superintendents and purchasing agents. Industrials have been Moody's especial field from the first issue, and in this division its lead is absolute and unquestioned. The fifth section, devoted to gas and electric lighting companies, is especially complete with over 1,000 entries, as to large corporations. The franchise provision, always a vital factor in the estimate of these quasi-public utilities, is clearly set forth, as well as the equipment, capitalization, earnings, management, etc. There are 734 more entries in this section than in the three other best known hand books combined referring to the same subjects. In the telegraph, telephone and cable section, Moody's Manual is equally copious and satisfactory. These two sections are notably complete and especial effort has been made in the section last named to exclude all paper schemes. The Manual also contains statements of upwards of 8,000 banks, trust companies and financial institutions, showing capital, surplus, profits, deposits, par value of shares, rates and dates of dividends, price of stock, officers, directors and correspondents; statements of American and foreign government and State securities and membership list of 27 different stock exchanges in the United States and Canada.

News of the Trade.

THE EXCELLO ARC LAMP COMPANY, 24 East 21st Street, New York, reports among recent sales, the purchase of fourteen flaming arc lamps by the Erie Railroad Company. These will be part "Sunray" and part "Pearl-White," and will be used to light the waiting room, driveway and ferry slip at the foot of 23rd Street, New York City.

THE BAY STATE LAMP COMPANY, of Danvers, has started up again after its annual summer shut-down. The increasing business of the company made necessary a considerable addition, which has just been completed. During the vacation also, a number of alterations and improvements in the factory were made for the better handling of the Fall and Winter business.

THE LEEDS & NORTHRUP COMPANY announces that it is now occupying a new shop and laboratory at 4901 Stetson Ave., Philadelphia. The new building is 110 ft. by 55 ft., three stories high, built with brick walls and reinforced concrete floors and roofs. The company has issued a well-illustrated pamphlet describing its building and giving an outline of the electrical instruments which it manufactures.

IN A FURNITURE PLANT.—The use of electricity in a furniture plant was described in these columns recently, in relation to the factory of the Horrocks Desk Company, at Herkimer, N. Y. The motors are of Allis-Chalmers make, Bullock type. The prime movers are Harrisburg Fleming engines, four valve type, made by the Harrisburg Foundry and Machine Works, and are giving complete satisfaction. They are running daily in parallel, being direct connected to alternating-current generators.

SHAWMUT STANDARD TERMINAL FUSES.—The Chase-Shawmut Co., of Newburyport, Mass., has just introduced its Shawmut extended terminal fuses. These fuses are made with an extended terminal on one end in a manner that will permit them to be used or interchanged on any standard type "A" enclosed fuse block. They possess many points of superiority as they simplify the stock of goods to be carried. The extended terminals are made of soft copper and are scored at different standard lengths. They may be cut off at any desirable point.

ADJUSTABLE LAMP FIXTURES.—The Gail-Webb Manufacturing Company, of Buffalo, has recently placed on the market several new types of adjustable incandescent lamp fixtures and portables for complete office and shop equipment. Among them is an adjustable wall fixture, which is 2½ feet long when telescoped and 4½ feet extended. It has a ball and socket joint at the upper end, allowing the rods to stand at any angle, while the joint at the lower end and the sleeve attached to the arm afford means of turning the lamp in any direction. Once adjusted, the joints require no further attention. One of the company's new styles of adjustable ceiling fixtures is of similar design, the base or bracket being made suitable for ceiling use. These fixtures are proving very desirable for offices, drafting rooms, etc. The universal electric light holder manufactured by this company has been improved by using case-hardened steel swivel blocks at the universal joints, wing nuts at the lower joint, and offsets in the bands at the sliding joint insuring free motion of the rods. As a result, the fixture is even more satisfactory than heretofore.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, S. S. Sadtler, 59 S. 10th St., Philadelphia. Next meeting, New York City, September or October, 1906.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty St., New York. Meetings, fourth Friday of each month.

AMERICAN RAILWAY, MECHANICAL & ELECTRICAL ASSOCIATION. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 12 West 31st St., New York.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y. Next meeting, Birmingham, Ala., Oct. 2-5, 1906.

AMERICAN STREET & INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, 60 Wall St., New York. Next convention, Columbus Ohio, Oct. 15-20, 1906.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, Geo. R. Stetson, New Bedford, Mass. Next meeting, Hotel Frontenac, St. Lawrence River, Sept. 4, 5 and 6.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P W. Drew, Milwaukee, Wis. Next meeting, Atlantic City, N. J., June 19, 1907.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Welles E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston on third Wednesday in March.

CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, P. T. Whittier, Spencer, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, Toronto Ont.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, George B. Tripp, Colorado Springs, Col. Next meeting, Denver, Col., Sept. 18, 19 and 20, 1906.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November, 1906.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

ELECTRIC CLUB OF CLEVELAND. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

ELECTRIC CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Chas. J. Sutter, 1220 Pine St., St. Louis, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary-Treasurer, Geo. H. Erich, 401 Monadnock Block, Chicago. Next annual meeting, Chicago, January, 1907.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, Marquette Building, Chicago. Next meeting, Chicago, Nov. 1, 1906.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays each month.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, Wm. R. Stavely, Royal Insurance Building, Montreal, Can. Next annual meeting, January 14, 1907.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliot, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall Street, New York. Board of Directors meets second Friday of each month.

EMPIRE STATE GAS AND ELECTRICAL ASSOCIATION. Secretary, T. R. Beal. Poughkeepsie, N. Y. Annual meeting, October, 1906.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill. Next meeting, Springfield, Ill., Sept. 19 and 20.

ILLUMINATING ENGINEERING SOCIETY. Secretary, Dr. Arthur H. Elliot, 4 Irving Place, New York. Meetings in New York, second Friday of each month.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INDIANA ELECTRIC RAILWAY ASSOCIATION. Secretary, P. H. White, Indianapolis, Ind. Monthly meetings, second Tuesday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Norfolk, Va.

IOWA ELECTRICAL ASSOCIATION. Secretary, L. B. Spinney, Iowa State College, Ames, Ia.

IOWA STREET AND INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia.

IOWA TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Ia.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Lawrence, Kan., Oct., 1906.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October each year.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress St., Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich. Next meeting, Oct. 16, 1906.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James F Barnett.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee Street, Utica, N. Y. Next meeting, New York City, 1907.

NATIONAL-INTERSTATE TELEPHONE ASSOCIATION. Secretary, A. L. Tetu, Nashville, Tenn.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. C. L. Eglin, Philadelphia, Pa.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty Street, New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, T. S. Lane, 536 Ellicott Square, Buffalo, N. Y.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, B. C. Adams, Madison, Wis.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, O.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Portsmouth, O.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, F. W. Bullard, Cleveland, O.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Chas. Currie, Akron, O.

OLD TIME TELEGRAPHERS AND HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York. Next meeting, Washington, D. C., Oct. 9, 10 and 11, 1906.

PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUG. 21, 1906.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

WAY CROSSINGS; Charles R. Barnes and Alfred Green, Rochester, N. Y. App. filed Nov. 12, 1903. On each of the tracks adjacent the point of intersection is placed an electro-magnetic device which can be actuated to derail the train in case the latter disregards semaphore signals set against it.

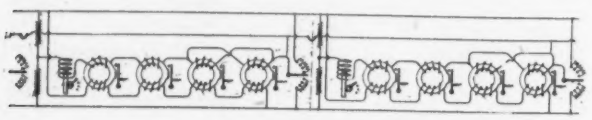
828,879. AUTOMATIC ELECTRIC BRAKE; Augustus L. Duwelius, Cincinnati, O. App. filed May 7, 1904. Has a small series generator directly geared to the wheel axles and which supplies current for a magnetic clutch which releases the brakes whenever the wheels wholly cease to revolve or "skid."

828,890. TELEGRAPHY; Charles A. Johnson, Meadville, Pa. App. filed Nov. 11, 1905. A pole changing transmitter for quadruplex telegraphy designed to obviate sparking at the contacts. The terminals and the vibrating lever all have connections which are coiled into inductive relation.

828,945. PORTABLE ELECTRIC DRILLING MACHINE; John Maclean, Ilford, England. App. filed Jan. 12, 1906. Mechanical details of an electric drill having a motor with planetary reduction gearing to the drill spindle and having a feed screw intermittently rotated by a ratchet lever.

828,946. TELEPHONE RECEIVER; Ray H. Manson, Elyria, O. App. filed Aug. 3, 1904.

828,966. SELECTIVE SIGNALING SYSTEM; Sylvanus A. Reed, New York, N. Y. App. filed Oct. 26, 1905. Employs alternating currents of different periodicity which are selectively operative on the bells



829,139.—Single Pilot Wire Control System.

of different subscriber's sets in an extension line. The ringers are "oppositely biased" and have condensers in series therewith.

828,976. PROCESS FOR RAPID HARDENING OF CEMENT; Herman Schneider, Cincinnati, O. App. filed April 27, 1906. The process of rapidly hardening cement which consists in passing through the cement material, when mixed with water, a current of electricity of a strength sufficient to heat the mass to prevent freezing.

828,980. ELECTRIC CIRCUIT AND APPARATUS FOR RAILWAY SIGNALING; Henry W. Spang, New York, N. Y. App. filed Aug. 21, 1902. A circuit is completed between the forward wheels of a train and the rearward ones through alarm devices in the locomotive cab when the train passes from one section to another of the track.

828,983. ELEVATOR BRAKE; August Sundh, Yonkers, N. Y. App. filed Jan. 11, 1905. The brake drum has internally acting shoes of which one is set by the frictional engagement of the other. Electro-magnetic means are provided for increasing the braking action after the shoes are in engagement.

829,015. ELECTRIC MACHINE; William A. Johnson, Toronto, Canada. App. filed Jan. 13, 1905. An alternating current generator of the type having a field in the form of an iron clad magnet with internal horns of oppositely north and south polarity.

829,026. CEILING BLOCK AND ELECTRIC CUT-OUT FOR INCANDESCENT LAMPS; James A. Mebane, South Boston, Va. App. filed June 29, 1903. A two-part rosette comprising a porcelain base and cover with metallic clips which serve the double purpose of holding the cover upon the base, and making the terminal connections.

829,027. ELECTRIC LAMP SOCKET; James A. Mebane, South Boston, Va. App. filed July 10, 1905. A special form of bayonet fastening between the housing and the outer cap of an incandescent lamp receptacle.

829,032. POWER BRAKE; Louis Pfingst, Boston, Mass. App. filed Nov. 4, 1904. A special controller box is provided for the brake spindle and an electric motor is contained therein and geared to the brake spindle so that either the hand lever or the power motor are available to set the brakes, either separately or together, from the same operating handle.

829,043. CUT-OUT; Frank T. Wheeler, Southington, Conn. App. filed Oct. 22, 1904. The base has terminal clips, and the cap has projecting hooks which may be engaged therewith to hold the cap in place and establish the electric connections.

829,055. LIGHTNING ARRESTER; John E. Brelsford and John W. Lutz, Dayton, O. App. filed Jan. 30, 1905. The line wire to be protected has an insulating block secured thereto which carries a metal tube with a notched end in proximity to a metallic plate connected with the line wire. The tube is grounded.

829,092. TELEPHONE-SWITCHBOARD LAMP; Joseph L. Wright, Washington, D. C. App. filed May 10, 1905.

829,103. WATER LEVEL ALARM FOR EXPANSION DRUMS OF HOT WATER HEATING SYSTEMS; Robert M. Dixon, East Orange, N. J. App. filed Nov. 19, 1903. Mechanical details for supporting a float within the reservoir which drops to establish an alarm circuit when it is no longer supported by the fluid level. The entire device is capable of being inserted through a small threaded hole in the reservoir wall.

829,109. TROLLEY WHEEL FORK; Edward W. Keating, Terre Haute, Ind. App. filed Feb. 3, 1906. The trolley harp has a pair of vertically projecting swiveled rollers on either side of the wheel. The rollers are capable of spring movement in either direction.

829,122. COMBINED BATTERY AND BELL; Jules A. Ny and Frederick Meadows, Oakland, Cal. App. filed Aug. 23, 1905. The bell casing has a cavity in which a small dry battery may be inset so as to automatically establish the electrical connection.

829,132. ELECTRIC SEMAPHORE; Jean F. Webb, Denver, Col. App. filed Aug. 22, 1905. Has means for releasing the semaphore locking devices to allow the arm to move to danger position, and at the same time operates an independent signal to the operator's station.

829,133. MEANS FOR CONTROLLING SELF-EXCITING GENERATORS. Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed July 20, 1905.

829,135. MOTOR CONTROL SYSTEM; Charles E. Bennett, New York, N. Y. App. filed Dec. 28, 1905. Provides an inexpensive installation by which trolley cars may operate with substantially all the advantages of the contactor system used on electric trains. The patentee provides for the breaking of all arcs beneath the floor of the car, both in case of overload, and whenever the circuit is intentionally opened by the motorman. In this way the danger and destruction of the usual controller is wholly avoided.

829,139. SINGLE PILOT WIRE CONTROL SYSTEM; Charles M. Clark, Summit, N. J. App. filed May 16, 1906. Provides for the complete multiple unit control of trains over a single pilot wire connection. The pilot circuit is controllable from any car platform and actuates selective relays simultaneously on the different cars.

829,142. RAILWAY TRAFFIC CONTROLLING SYSTEM; Clarence W. Coleman, Westfield, N. J. App. filed Feb. 15, 1904. Overlap system making use of track rails charged to alternating potential difference.

829,144. ELECTRIC MOTOR CONTROL; Maxwell W. Day, Schenectady, N. Y. App. filed June 27, 1904. Relates to a system where speed control is obtained by driving a motor from a generator and varying the field strength of the generator. Patentee provides for two motors, and has means for preventing the speed controlling switch from weakening the field of one motor when the other motor is cut out.

829,148. RHEOSTAT; Arthur L. Hadley, Fort Wayne, Ind. App. filed Dec. 16, 1904. The rheostat has two separate removable contact brushes and circuits by which the resistance elements are separately included in the field and in the armature circuits.

829,151. MOTOR STARTING RHEOSTAT; John L. Hall and William C. Yates, Schenectady, N. Y. App. filed Aug. 23, 1904. The contactors are operated by powerful magnets which are, however, automatically cut out as soon as the contactor has operated. A small holding coil is effective to keep the contactor closed until released by the motorman.

829,162. CIRCUIT MAKER AND BREAKER; Charles J. Klein, New York, N. Y. App. filed Aug. 6, 1904. The switch lever has a spring blade connection which is capable of being buckled to impel the lever in one or the other direction. A pair of buttons are arranged to properly buckle the spring blade.

829,164. TELEPHONE TRUNKING SYSTEM; Jacob W. Lattig, Wyncote and Charles L. Goodrum, Philadelphia, Pa. App. filed Oct. 22, 1903.

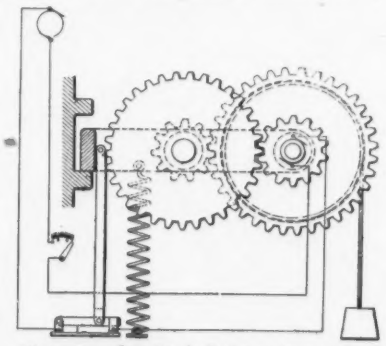
829,174. RESISTANCE UNIT; Ernest Schallner, Schenectady, N. Y. App. filed March 31, 1904.

829,192. ELECTRICAL SIGNALING DEVICE; Clinton M. Allen, Bay City, Mich. App. filed Oct. 23, 1905. An adaptation of a wireless signaling system to use on trains. An antenna wire is stretched alongside the track and the train has a knob constituting an antenna in proximity thereto.

829,241. RAILWAY SIGNAL SYSTEM; Robert O. Turner, Barre, Vt. App. filed Feb. 5, 1906. A series of conductors are stretched alongside the track and spring blades on the locomtive engage the same to receive or transmit a signal.

829,263. APPARATUS FOR THE TELEGRAPHIC TRANSMISSION OF WRITTEN CHARACTERS; Adolf Franke, Gross Lichterfelde, Germany. App. filed Oct. 17, 1902. Synchronously revolving wheels at the transmitting and at the receiving station have written characters which successively appear through an apertured screen. The characters are selected by being illuminated from a properly timed spark in a definite phase relation to the rotating wheel.

829,272. MOTOR STARTING RHEOSTAT; Dugald C. Jackson, Madison, Wis. App. filed May 21, 1906. The rheostat has two switch levers respectively adapted for opening the circuit in case of "overload" and "no-voltage." Has a mechanical connection by which the "no-



829,371.—Overload Safety Apparatus.

voltage" or starting lever cannot be moved until the overload lever is moved into closed relation.

829,308. PROCESS OF ELECTROLYTICALLY TREATING MILK; Charles T. Willson, Amenia, N. Y. App. filed Jan. 30, 1906. The process of treating skimmed milk which consists in passing a direct current of electricity through the milk to separate the curd from the whey.

829,309. AUTOMATIC RAILWAY BLOCK SIGNAL; Harry M. Abernethy, Cleveland, O. App. filed Jan. 25, 1906. Mechanical details of a semaphore signal operated by an electric motor through an intermediate magnetic clutch.

829,318. ELECTRIC HEATER; Axel H. Carlson, Philadelphia, Pa. App. filed June 30, 1905. A rectangular box has partitions therein by which a fluid current is made to traverse a zigzag course. Heating coils are embedded in the bottom of the box.

829,340. STARTING DEVICE FOR ELECTRIC MOTORS; Martin Kallmann, Berlin, Germany. App. filed Aug. 22, 1905. A form of resistance comprising a bundle of thin iron wires enclosed within a sealed casing and surrounded by non-oxidizing gases.

829,371. OVERLOAD SAFETY APPARATUS; Philip J. Darlington, Glenridge, N. J. App. filed Apr. 26, 1904. The motor is arranged in the form of a scale balance so as to tip up and open the power circuit whenever the load is above its maximum.

829,373. ELECTRICAL BALLAST MOUNT; Claude D. Enochs, La Crosse, Wis. App. filed Aug. 3, 1905. A glass bulb has a central stem around which is spirally wound a resistance conductor. The bulb is exhausted of air in the manner of an ordinary incandescent lamp.